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ABSTRACT

The study reported in this document was conducted to identify, describe, and assess the potential of innovative approaches to integrating vocational and academic education as one way of helping students to understand the utility of academic learning. Research activities included case studies of five integrated-curriculum programs in California, New York, Ohio, and Pennsylvania; a literature review; consultation with experts; and cross-site analysis of integration issues. The study found that innovative efforts to achieve a new relationship and closer alignment between vocational and academic curriculum and instruction appear to be a highly promising trend. Some of the findings are the following: (1) curriculum development and professional development are key activities for implementing an integrated vocational/academic curriculum; (2) both academic and vocational instructors should be involved from the start; (3) social, intellectual, and physical barriers between the vocational and academic staff must be breached; (4) 5 years is a minimum time to integrate the curricula; (5) curriculum integration efforts should not be focused strictly on "high technology" subjects at the expense of more traditional subjects; and (6) evaluation is weak in most programs, providing only anecdotal evidence of student benefit from curriculum integration. The report concludes that further research is needed but that vocational education can play a strengthened role in an integrated curriculum, especially if state support is provided. (Appendices comprising the bulk of the document include the five case studies, examples of technical writing assignments, and a 52-item bibliography.) (KC)

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THE CASE FOR INTEGRATING ACADEMIC AND VOCATIONAL EDUCATION

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EXECUTIVE SUMMARY

Section 403(a) of the Carl D. Perkins Act directs the National Assessment of Vocational Education (NAVE) to include descriptions and evaluations of "the impact of vocational education programs on the achievement of academic skills . . . of students." Among the studies commissioned by the NAVE to address this requirement was a small project to search out and describe local educational settings where unusual efforts are being made to integrate or align vocational and academic curricula. The results of that search are reported in this volume; five detailed case studies are appended to the report.

The Issue

In recent years, several provocative articles by mainstream researchers in the field of cognitive science have suggested that the essential structure of our traditional approach to curriculum and instruction makes little sense, particularly at the secondary school level. For example, the structure of schooling presumes that all students learn best through linguistic and logical-mathematical modes of instruction. Furthermore, content is delivered through isolated "boxes" (courses) that allow neither teachers nor students much opportunity for understanding the connectedness or utility of academic learning to real life applications. For some students--perhaps many, a different approach might improve both motivation and achievement.

Vocational education provides a natural setting in which to experiment with creating new connections between academic learning and the uses of that learning. For many reasons, however, the full potential of the vocational classroom has not been developed. Educators, researchers, and policymakers tend to think of vocational education in isolation from the rest of the educational enterprise and frequently in pejorative terms. The result is that an important resource and a major educational investment is probably being underutilized.

Study Purposes and Methods

The principal purpose of this study was to identify, describe, and assess the potential of innovative approaches to integrating vocational and academic education as one way of helping students to understand the utility of academic learning. In defining the parameters of the study, we deliberately avoided use of the term "basic skills," which too often has a minimalist connotation. Instead, we use the term "academic skills," which implies both a broader range of skills (thinking, problem solving, and comprehension as well as the "3 Rs") and a higher level of difficulty (for example, algebra as well as general math). During site selection, use of this definition eliminated settings where the mathematics and communications skills being reinforced in vocational classrooms were clearly basic or remedial in nature. Our interest focused on efforts where an integrated vocational/academic program of study presented challenging material in an applied context.

Activities undertaken to accomplish the purpose of the study included the following:

- A word-of-mouth search for sites where educators were attempting to redefine the relationship between vocational and academic education
- A literature review that focused on current thinking about skills needed in the workplace and on cognitive research
- Preparation of detailed case studies based on site visits to schools in five localities
- Consultation with a panel of experts from the fields of vocational education, curriculum, cognitive science, psychometrics, and program evaluation
- Cross-site analyses of issues relevant to the planning, implementation, evaluation, and replication of an integrated approach to vocational and academic education

The sites visited for the study are located in California, New York, Ohio, and Pennsylvania. One effort is state-mandated, two are state-encouraged, and the remaining two originated at the district or school level.

Study Findings

Overall, innovative efforts to achieve a new relationship and closer alignment between vocational and academic curriculum and instruction appear to be a highly promising trend for secondary education. The task, however, is both complex and difficult if it is to be done well. Among our primary findings are the following:

- Curriculum development and professional development are the key activities associated with implementing an integrated vocational/academic curriculum.
- It is preferable to have both academic and vocational instructors involved in the innovation from the start.
- Some funding is needed to support professional and curriculum development activities.

- There are often significant social, intellectual, and even physical barriers between the vocational and academic staff in a high school that must be breached in order to make curriculum integration work. It is in this area, in particular, that strong leadership is needed.

- Restructuring the relationship between academic and vocational education takes a long time; five years is probably a realistic minimum timeframe.

- In most cases, evaluation is a weak component in program design and implementation. It is therefore difficult to determine how much impact an applied approach to academics has had on student achievement. There is anecdotal evidence that applied curricula seem to stimulate students to become more engaged in classroom academic tasks.

- There appears to be some danger that expansion of curriculum integration efforts will focus heavily on "high tech" vocational programs to the exclusion of more traditional vocational education departments. This would be unfortunate since many of the students who are the most disaffected from their academic work are enrolled in traditional vocational programs.

- Mainstream educational and cognitive research has not addressed the potential value of teaching academics in a vocational setting.

Implications

The Need for Research

Efforts to integrate or align academic and vocational curricula represent an exciting but still emerging educational trend that should be taken very seriously. It is not now and should not become a strictly voctional movement since it requires the cooperation of both academic and vocational educators. In the long run, it will be important for mainstream educational and psychological researchers to undertake carefully controlled studies of what and how high school students learn in applied contexts. Currently, cognitive research focuses on learning in traditional academic classrooms and on the job, thus leapfrogging over the one place in high schools where the workplace is simulated. Since the mainstream research community has tended to either ignore or denigrate vocational education, care must be taken to ensure that such studies begin from a neutral position, allowing the possibility that applied academics may be the preferred approach for some students.

A New Role for Vocational Education

One of the most positive outcomes of efforts to integrate vocational and academic curricula is a new respect for vocational education as part of the solution rather than part of the problem. While both academic and vocational teachers must participate in order to make a new approach work, it is particularly significant that vocational educators in several of the sites visited have assumed a leadership role in conceptualizing, planning, and implementing a new relationship between vocational and academic curriculum and instruction. This appears to signal both a new assertiveness and a retreat from defensiveness on the part of at least some vocational educators. Furthermore, given new emphases on coordinating "basic skills" instruction with pre-employment or job training that appears in several pieces of federal legislation (e.g., JTPA and the new Part C of the Chapter 1 legislation), the experiences of vocational educators in creating innovative approaches to curriculum integration may become an important resource for a much broader spectrum of efforts to improve education for "the forgotten half."

The Importance of Time

In taking steps to encourage new relationships between academic and vocational education, policymakers should not underestimate the amount of time required to restructure firmly entrenched attitudes and behaviors. Standard three-year funding cycles, for example, may only carry such an innovation through planning and early implementation. Certainly three years is not long enough for accumulation of definitive student outcome data if a program covers all four years of high school. Nor does it allow time for the inevitable mid-course corrections associated with trekking in uncharted territory. In this context, both innovators and funders should have a mutual understanding of a realistic timeframe and appropriate milestones in order to give such experiments a fair chance to develop.

Evaluation and Assessment

Schools and school districts that are or will be experimenting with integrating vocational and academic education need expert assistance in identifying or developing appropriate instruments for student assessment and in designing rigorous program evaluation plans. There is probably no sense in pursuing a difficult task like aligning vocational/academic curriculum and instruction unless it can be demonstrated to make a significant difference in student learning. In order to accomplish this, serious thought must be given to the types of assessment that can best measure mastery of academic learning in an applied context. Furthermore, innovative programs should be conducting formative evaluations on a regular basis in order to make adjustments in content or approach as needed. The National Center for Research in Vocational Education (NCRVE) seems to be a logical choice to coordinate assistance in this area.

State Support

States can mandate curricular change (as in the case of New York), provide direct funding incentives for innovation (as in California), or endorse programmatic options (as in Ohio). At the very least, given the documented low achievement levels of the average American youth, states should not penalize schools and school districts for experimenting with new approaches to curriculum and instruction. This may require bending or changing the rules for state vocational funds allocation.

ACKNOWLEDGMENTS

This report is the result of interviews and conversations with a number of dedicated and enthusiastic educators who have taken innovative steps toward new ways of looking at the relationship between vocational and academic education. Without their hospitality and their candor, we would have had no story to tell. We would particularly like to thank the administrators and teachers in the following schools and programs:

The Oakland Health Academy, Oakland Technical High School, Oakland, California

Livingston Junior High School and Albany High School, Albany, New York

Shaker High School, Colonie, New York

Montgomery County Joint Vocational School, Clayton, Ohio

Dauphin County Technical School, Harrisburg, Pennsylvania

The High Technology Magnet Program, Schenley High School Teacher Center, Pittsburgh, Pennsylvania

We admire the educators we met in these settings for their willingness to take risks and lead the way. The goals that they have set for themselves are not easy to accomplish.

The study benefited from the assistance of an advisory panel that convened to discuss the results and implications of what we had learned in the field. We are indebted to Dr. Gene Bottoms, Dr. Susan Chipman, Dr. Willard Daggett, Dr. Harry Passow, Dr. Susan Sherman, and Dr. David Stern for the multiple perspectives that they brought to bear on a complex matter. We would also like to thank Dr. John Wirt, Director of the National Assessment of Vocational Education; and Dr. Charles Benson, Director of the National Center for Research in Vocational Education, for their valuable comments and questions.

Finally, we are especially grateful for the wholehearted support and deft facilitation of our project officer for the study, Ms. Dorothy Shuler. She challenged us to ask hard questions, smoothed rough passages, and generously shared her extensive knowledge of vocational education. We salute her and wish her well.

The study team included Dr. Nancy Adelman, Dr. Becky Hayward, Ms. Rosalind Hamar, and Ms. Joanne Bogart. In addition to her fieldwork contributions, Dr. Hayward also provided valuable substantive and editorial commentary on the final report. Ms. Margaret Thompson prepared the manuscript.

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CHAPTER I

Introduction

The architects of the Carl D. Perkins Act, passed in 1984, believed that secondary vocational education should play a more prominent role in basic skills instruction. Section 402(a) of the Act calls for research on "successful methods of reinforcing and enhancing basic academic skills in vocational settings," while Section 403(a) specifically directs the National Assessment of Vocational Education (NAVE) to include descriptions and evaluations of "the impact of vocational education programs on the achievement of academic skills . . . of students." The use of the term "academic skills" in this context is significant. Basic skills are widely understood to be the classic "3 Rs"--the fundamental reading, writing, and 'rithmetic skills that students should (but often don't) master before they reach high school. On the other hand, the concept of academic skills implies both a broader range of skills (thinking, problem solving, and comprehension, as well as the "3 Rs," for example) and a higher level of difficulty (algebra as well as general math, applied biology or physics as well as general science). Congress chose to use the more comprehensive term, as have we in conducting this study.

One purpose of the study reported on in this volume is to provide NAVE and the Congress with specific information on the nature of innovative approaches to the integration of vocational and academic education in secondary schools. The study team identified and visited five sites, representing five different approaches to establishing stronger linkages between the academic core and vocational programs. These approaches are analyzed and discussed in Chapter II of the report. Full case studies of the visits appear as Appendix A.

A second purpose of our work has been to examine the degree to which any innovative approaches to integrating vocational and academic education (1) reflect the needs of the workplace and (2) are grounded, or could be grounded, in recent theories and research about the ways in which people learn. Based on previous fieldwork for the National Assessment and on our general knowledge of current trends in vocational education, our expectation was that efforts to change the presentation or scope of vocational curricula or programming would be strongly rooted in the personal teaching experiences or understandings about the job market of the innovators and/or intuitive understandings or beliefs about the ways in which students learn, rather than in research findings per se. This expectation proved correct. In terms of the research literature, our job, then, became one of attempting to deduce whether or not any findings from cognitive and learning theory research could at least in part explain practitioners' convictions about how to improve vocational education. The perspective we obtained through examination of this literature is presented in Chapter III of the report.

Background for the Surge of Interest in Integrating Vocational and Academic Instruction

In the early 1980s when a multitude of commissions, foundations, and others examined the status of the American high school and found it wanting, most critics were delighted--if somewhat astonished--to discover that what employers said they most wanted were reliable hirees with a good grounding in the essentials of reading, writing, and arithmetic. This position conveniently supported the major recommendations that these bodies were poised to make--namely that high schools should increase the academic requirements for graduation. The most prominent of the reports--A Nation at Risk--advocated an academic core of 13-1/2 Carnegie units in the "new basics," consisting of four years of English, three of math, three of science, three of social studies, and a half year of computer science.[1] Not surprisingly, the "new basics" made no mention of vocational requirements for high school graduation. Nor was there any serious talk of a possible supporting role for vocational education as states, districts, and schools responded to the call for stiffer graduation requirements and greater mastery of what were generally referred to as basic skills. To many minds, vocational education was part of the problem--a component of the insidious "rising tide of mediocrity" that threatened to undermine the nation's competitiveness and productivity.

Thus essentially left out of the first round of debate on educational reform, vocational educators crafted their own clarion cry. In many ways, The Unfinished Agenda, a report of the National Commission on Secondary Vocational Education, was a more perceptive and forward-looking document than A Nation at Risk.[2] This Commission correctly observed that, as most commonly configured, both academic and vocational courses are isolated, arbitrary, and fragmented pieces of learning that do not offer students opportunities to make connections about the "interrelatedness of ideas, the implications and applications of knowledge, and the process of discovery, dissemination, and use of information." They called for a joint effort of vocational and academic educators to "bridge the gap" between theoretical and practical education. Recognizing that this full-fledged coordination must be a long-term goal, the report recommended that in the immediate future, secondary vocational courses should shoulder some of the responsibility for instructing students in "the basic skills of reading, writing, arithmetic, speaking, listening, and problem-solving."

While in some sense The Unfinished Agenda was a defensive document intended to reassert vocational education's claim to an eroding piece of the secondary school turf and to a seat at the negotiating table on educational reform, it was also politically and educationally astute, a fact that becomes increasingly apparent every day. Very recently, for example, a major study funded by the W. T. Grant Foundation concluded that "a mixture of abstract and experiential learning opportunities, a combination of conceptual study with concrete applications and practical problem-solving" offers one of the most hopeful approaches to improving the education of the 20 million young Americans who are not college-bound.[3]

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[1] U.S. Department of Education, The National Commission on Excellence in Education, A Nation at Risk: The Imperative for Education Reform. Washington, D.C.: U.S. Government Printing Office, 1983.

[2] The National commission on Secondary Vocational Education. The Unfinished Agenda: The Role of Vocational Education in the High School. Columbus, Ohio: The National Center for Research in Vocational Education, 1984.

Despite analyses such as these, however, mainstream educational researchers, theorists, and policymakers have thus far failed to consider vocational education seriously--in combination with applied academics--as part of the solution for improving educational outcomes, particularly for those noncollege-bound youth whom the Grant Foundation report terms "the forgotten half." In fact, some highly prominent researchers have written eloquently and provocatively about the curricular and instructional dissonance between the conventional approach to schooling and such important factors as the diversity in dominant student learning styles and the utility of a traditional education for real world settings. Perhaps because of the well-recognized stigma attached to vocational education--or more likely because vocational education does not typically show up on the mainstream education or psychology researcher's radar screen--the logical connections between their theories or observations and the types of learning opportunities offered by vocational education are overlooked. Two examples illustrate the point.

Dr. Howard Gardner of Harvard University's Project Zero has challenged the idea that human intellect is a unidimensional, overarching faculty. Instead, he has articulated a theory of "multiple intelligences," suggesting that, at a minimum, there are seven ways in which an individual can be intellectually talented.[4] Based on evidence from a wide range of research disciplines including anthropology, biology, and psychology, Dr. Gardner's nominations for the distinctive ways that one can be "smart" are:

- Linguistic intelligence--sensitivity to the meaning and order of words and the varied uses of language.
- Logical-mathematical intelligence--the ability to handle long chains of reasoning and to recognize patterns and order in the world.
- Spatial intelligence--the ability to perceive the visual world accurately and to recreate, transform, or modify aspects of that world based on one's perceptions.

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[3] Youth and America's Future: The William T. Grant Foundation Commission on Work, Family and Citizenship. The Forgotten Half: Pathways to Success for America's Youth and Young Families. Washington, D.C.: Author, November 1988.

[4] Howard Gardner. Frames of Mind: The Theory of Multiple Intelligences. New York: Basic Books, 1983.

- Bodily-kinesthetic intelligence--a fine-tuned ability to use the body and to handle objects.

- Musical intelligence--sensitivity to pitch, melody, rhythm, and tone.

- Interpersonal intelligence--the ability to notice and make distinctions among others.

- Intrapersonal intelligence--access to one's own "feeling life."

While individuals may possess several or all of these intelligences, Gardner argues that we tend to have preferred intellectual proclivities that can be identified, assessed, and built upon in learning situations. The traditional forms of schooling are heavily oriented toward developing the linguistic and logical-mathematical intelligences through a uniform curriculum, a single dominant instructional mode, and standardized tests. Gardner does not dispute the need for a core curriculum that transmits the critical elements of our common culture to all students. He argues, however, that our tunnel vision concerning the way in which we deliver the common culture in the classroom is costing us a great loss of human talent:

> So long as a uniform curriculum is embraced, most individuals are destined to emerge as untalented. Not only is there little room at the top; but standardized regimens tend to favor individuals who exhibit certain intellectual profiles, ones which may be valuable for the aforementioned curricula but need not signal success outside the scholastic setting.
>
> . . . .In human history there have been many alternative models of learning, including apprenticeships, mentorships, on-the-job training;. . . .[5]

Where is it in the typical American high school that one hears about training and apprenticeships? Without radically restructuring the schools, in which classrooms might the multiple talents of students whose dominant proclivity may be bodily-kinesthetic, spatial, or interpersonal be effectively developed? It seems to us that the staff of Project Zero might well want to look carefully at the potential of vocational shops and labs for fostering the type of talent-based, individualized education that they advocate.

Gardner and his colleagues are not alone in raising provocative questions about our standard approach to schooling. Lauren Resnick, a cognitive psychologist and past president of the American Educational Research Association, has recently suggested that there are some fundamental discontinuities between the education we receive in school and the knowledge or approaches to learning that we need for daily life and work.[6] As examples, she cites four fundamental characteristics of schooling that are in direct contrast to behavioral norms outside of school:

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[5] Howard Gardner. "An Individual-Centered Curriculum." In The Schools We've Got, The Schools We Need. Washington, D.C.: Council of Chief State School Officers, 1987, pp. 94-95.

(1) In school, learning and assessment of what has been learned are almost exclusively individual activities. Outside of school, on the other hand, most activity is socially shared and "success" is the result of group effort.

(2) In school, the bottom line is what students are able to do unaided by external supports or "tools," i.e. books, notes, calculators, etc. In contrast, the use of tools is encouraged (or even required) in the world of work in order to increase both efficiency and accuracy.

(3) School learning is largely symbol-based and far removed from any connection to real objects, real events, or real problems. Research indicates that, in the real world, people routinely solve concrete problems easily and accurately that would stump them as paper exercises.

(4) The schools' mandate is and always has been to teach broadly applicable skills and theoretical principles that are presumed to be transferable. However, evidence is accumulating that the skills learned in school have limited transportability to specific situations outside of school.

After making these cogent observations that have an obvious ring of truth to them, Resnick offers some thoughts on how the dissonance between school-based learning and the practical applications of learning might be reduced. Her key recommendations include the following:

- development of "bridging apprenticeships" that use simulated work environments and specially designed social interactions to close the distance between theory and practice;

- research on (1) cognitive aspects of job performance and (2) the role that schools can play in developing the kinds of adaptive learners needed for an unpredictable and increasingly changeable workplace;

- research on how people develop competence or become experts in their jobs.

Note the echo here of Gardner's call for broader use of an apprenticeship model for schooling. Yet vocational education has no part in the agenda that Resnick lays out. In fact, she rejects secondary vocational education as an historically inappropriate vehicle that has unsuccessfully attempted to provide direct on-the-job training in schools. Without entering into debate on whether the central thrust of secondary vocational education is essentially exploratory or occupationally specific in nature, we suggest that peremptory dismissal of this entire sector of our current education system is premature, particularly in the context of observations such as those made by Resnick. Of all the classrooms in a secondary school, vocational shops and labs may come closest to bridging the disjuncture between school and the rest of the world. Certainly they offer the potential to do so. They are, therefore, a natural setting for experimenting with new and better articulated instructional strategies and curricula to prepare students for the world of work that nearly all will enter in the short or longer term.

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[6] Lauren B. Resnick. "Learning In School and Out," Educational Researcher, Vol. 16, No. 9, December 1987, pp. 13-20.

Modal Academic Instruction in Secondary Schools

In order to understand the "fit" between school learning and the kinds of skills and knowledge that are useful outside of school, we need to establish a picture of what the typical student experiences over four years of high school. Unfortunately, most data on the high school experience are at a very global level--numbers of Carnegie units required and taken in particular subject areas, for example. Such analyses are bolstered by the results of the National Assessment of Educational Progress (NAEP) and by a limited number of studies and case studies that yield a more textured description of what occurs behind the classroom door. The brief portrait we present here is highly generalized. Nevertheless, we believe it fairly represents an outline of the average high school student's educational experience.

There is no question that the total number of Carnegie units required for high school graduation has been steadily rising. (See Table I-1.) A decade ago, the average number of state-required Carnegie units for high school graduation was about 16--four courses per year. Today the average has risen to 21.

As Table I-1 makes clear, even with the increase in total required units, requirements in the core academic subjects have remained proportionately stable at about one-half of the total number of required units. Students fill the remaining half of the total credits needed with a combination of other kinds of requirements (e.g., physical education, fine arts, driver education, practical arts) and electives, which may be additional academics, vocational education, co-curricular courses such as band, chorus or journalism, work study or cooperative education placements, studio art, etc.

Since high school students have been taking increased numbers of academic courses in the past decade, including nearly twice as much math and science as the average student in the seventies, the expectation would be that they are also learning more--of something. In fact, scores for 17-year-olds on recent NAEP tests have improved. The 1984 reading assessment found that nearly all 17-year-olds can read basic materials and 84 percent can understand specific and general information found in quite lengthy

Table I-1

Longitudinal Comparison of
Required Units in Core Academic Subjects
For High School Students[a]

Core Subjects	1972	1980	1982	1985	1988
English	3.5	3.5	3.6	3.8	3.9
Social Studies	2.1	2.1	2.6	2.8	2.9
Mathematics	1.2	1.3	1.6	1.9	2.3
Science	1.2	1.2	1.5	1.8	2.0
TOTAL: Core subjects	8.0	8.1	9.3	10.3	11.1
TOTAL: All subjects	16.0			20.3	21.0

[a]Sources: State Graduation Requirements, National Education Association Research Service, May 1972; State Mandated Graduation Requirements, 1980, National Association of Secondary School Principals, 1980; OERI Bulletin, U.S. Department of Education, Center for Education Statistics, September 1986.

reading passages.[7] Thus, at least for most students who stay in school, functional illiteracy does not seem to be a problem. However, only 5 percent of this age group had mastered the most advanced reading skills and analysts estimate that 55 percent of white, 80 percent of Hispanic, and 84 percent of Black students probably have difficulty reading textbooks written at a high school level. In other words, improvement is a relative term.

High school students' writing skills are even more problematic. While most achieve reasonable mastery over the mechanics of writing (i.e., spelling, punctuation, usage, and construction of single sentences), only 20 percent are able to put their well-constructed sentences together into paragraphs that form an adequate persuasive letter and 38 percent can compose an adequate piece of informative prose.

The picture is bleakest in math. The 1986 NAEP assessment of students' proficiency in mathematics found that, despite an increase in students' average overall test score, only about half of 17-year-olds are able to perform moderately complex procedures, such as finding averages and interpreting graphs, skills that should be mastered in junior high school or even earlier. Most of the increase can be attributed to students' greater accuracy in performing basic operations on whole numbers. A minuscule 6 percent can solve multistep mathematical problems such as the following:

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[7] The most recent reading and mathematics assessments were conducted in 1986. However, because of serious methodological problems associated with the 1986 reading test, we have chosen to rely on results of the 1984 reading assessment in this profile.

> Christine borrowed $850 for one year from the Friendly Finance Company. If she paid 12 percent simple interest on the loan, what was the total amount she repaid?

As the report on this assessment sadly pointed out, "Translated into population figures, nearly 1.5 million 17-year-old students across the nation appear scarcely able to perform the kind of numerical applications that will likely be required of them in future life and work settings."[8]

Why, in spite of additional academic requirements, do achievement levels remain so abysmally low for the majority of high school students? The answer must lie behind the classroom door. That is precisely the impression one receives from the small number of studies that have examined a limited number of high schools in depth. There is, of course, in every high school some proportion of students who continue to be highly motivated by and engaged in the symbolic/linguistic/mathematical/logical structure of the standard instructional approach. But they are by no means the majority in most secondary schools. According to observers who have recently spent large chunks of time in high schools, a dominant profile of the average high school student is elusive. One study refers to the great middle 50 (or more) percent of a high school's student body as "the unspecial"--that is, students who are neither educationally handicapped nor accelerated.[9] In short, they are the average students who hang on through four years of high school, apparently adding little to their academic achievement levels as a result. Whether or not their personal aspirations include further education or a job right after high school, they are kids who are going through the motions, spinning their wheels, with one (half-closed) eye on enduring until they can "get out" and a second, much more alert eye on the enticing adult world that they will shortly enter.

The "contract" or "treaty" that such students have entered into with their teachers has been vividly described many times in recent years.[10] Essentially, the position is "If you don't hassle me, I won't hassle you."

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[8] Education Week, June 15, 1988, p. 23.

[9] Arthur G. Powell, Eleanor Farrar and David Cohen. The Shopping Mall High School: Winners and Losers in the Educational Marketplace. Boston, MA: Houghton Mifflin Company, 1985, pp. 173-184.

[10] See, for example, Theodore Sizer, Horace's Compromise: The Dilemma of the American High School, New York: Houghton Mifflin, 1984; Vito Perrone, Portraits of High Schools, Princeton, N.J.: The Carnegie Foundation for the Advancement of Teaching, 1985; Michael Sedlak et al., Selling Students Short: Classroom Bargains and Academic Reform in the American High School, New York: Teachers College Press, 1986.

From the students' perspective, "hassling" includes classwork, homework, and tests. A large part of their laziness, intransigence, or anti-intellectualism seems to stem from not seeing the point of abstract academic learning. For some who have never mastered the fundamental reading and math skills in the earlier grades, high school is simply a reprise of hated and fruitless drill and practice exercises at which they have failed many times over. Many of these students are so embarrassed, frustrated, and alienated by repeated failure that traditional instructional approaches in regular school settings are, by high school, totally inappropriate. Most students, however, could do the work _if_ they were motivated. For them, "Because you'll need it later" is simply not an acceptable answer to the age-old question "Why do we have to learn this?"

Would some or many of these students respond to a reconstituted curriculum that made much more explicit the connections between what they are required to study or asked to do in school and how that learning is applied in real-life situations? Is it possible to rearrange or open up the boxes into which various types of educational content have been stuffed? In short, could the potential of vocational education conceptualized at the beginning of this chapter be realized? These are the kinds of generic questions that we asked ourselves when we went searching for schools and programs that are experimenting with new relationships between vocational and academic education. The results of this search are described and analyzed in the following chapter.

CHAPTER II

Approaches to Integrating Vocational and Academic Education

Early in the study we began a word-of-mouth search for schools or programs that were taking unusual steps to bring about better integration of academic and vocational education. At the outset, we were clearer about what we were not looking for than about what we hoped to find. For example, we were not interested in programs where the reading and mathematics instruction associated with vocational education was explicitly remedial in nature. In our view, the vocational classroom is not an appropriate place to attempt to overcome serious educational deficits that have been 10 or 11 years in the making, although certainly vocational instructors can support and coordinate their efforts with other faculty who are qualified and trained to offer remediation. Nor were we simply interested in situations where certain traditional vocational courses count for academic credit. We knew from previous research that in a number of states, students may earn math, science, or English credit through enrollment in vocational courses such as Business Math and English, Machine Shop II (which often requires familiarity with algebra and trigonometric functions), or agricultural sciences.[1] Such courses are traditionally presumed to contain occupationally-related academic content presented with an equal or greater rigor than general track English, mathematics, and science offerings. They do not, however, represent any real change in the normative relationship between academic and vocational education.

In one specific instance, California's Hughes-Hart Educational Reform Act of 1983, which increased high school graduation requirements for all students, contains language allowing individual school districts to develop "alternate means" for achieving the requirements, including the possibility of granting academic credit for vocational courses. A study of seven districts in the state found that three basic methodologies had been established to determine course comparability: (1) cross-referencing of the content in regular academic and vocational courses (2) review and comparison of course outlines and textbooks; and (3) matching of written competencies. These are basically administrative exercises that do not require any serious rethinking of curricula or instructional strategies.

Essentially, what we were looking for were programs where educators had already raised their expectations for the role of vocational education in the overall high school program of studies. We hoped to find situations where practitioners and/or policymakers were attempting to engineer structural change in the substance of vocational education or in the relationship between vocational and academic education. We were particularly interested in the concept of curriculum alignment--that is, deliberate efforts to create day by day or week by week parallelism between the content being taught in math, science, or English classes and the application of this content in vocational shops and labs. It seemed to us that experiments in this direction might shed some real light on whether or not vocational education could play a prominent role in reducing the dissonance between in-school learning and the uses of that learning in real life and work. Needless to say, we were not inundated with nominations of places to visit. To the extent that interest in better integrating academic and vocational education can be called a movement, it is a movement in its infancy. There is a good deal more talk than action.

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[1] In 1984, 20 out of 41 states surveyed by the American Vocational Association allowed academic credit for vocational courses. See Gene Bottoms, "Now Is the Moment of Opportunity," Vocational Education (59), Oct. 1984, pp. 8-9.

Beyond our goal of identifying really innovative approaches, we had only one additional selection criterion--that the effort should have been underway for at least two years and preferably longer. Ultimately, we identified and visited five sites representing considerable variation in approach to the problem of integrating academic and vocational education. Case studies based on these visits appear as Appendix A to this report. In addition, through a member of the study's advisory committee, we have been privy to the growing pains of several newer projects that are developing under the auspices of the Southern Regional Education Board (SREB)-State Vocational Education Consortium. In the remainder of this chapter, we describe, compare, analyze, and weigh the relative merits of the strategies we observed.

Overview of the Five Sites

Table II-1 shows the range of school types and origins of the innovation across our five sites. In the three settings where the impetus for the innovation lay with the state, we sought advice on specific schools to visit from individuals who were knowledgeable about the extent, effectiveness, or uniqueness of program implementation at the local level. Thus, in New York, Ohio, and California we might have had different stories to tell if we had visited other sites.

New York. Beginning in the early 1980s, New York undertook a massive revision of its occupational and technical education programs. A fundamental principle underlying the new curricula is the belief that preparation for the current and future workplace requires broad, transferable skills that are adaptable to many work situations. After a lengthy and broadly-based planning stage involving business and industry, educational administrators and teachers, state educational policymakers, and students, the planners came to the conclusion that:

- Curricula should be packaged in small units or modules that are easily revised or replaced.

- All students in occupational education should take a set of core competencies related to personal development, social systems, information systems, resource management, and technology.

- These core competencies should be taught in a manner that cross-cuts all specific occupational programs.

Table II-1

Characteristics of the Five Sites

Location	School/Program Type	Source of Initiative
Albany, NY	Comprehensive high school	State-mandated
Colonie, NY	" " "	
Clayton, OH	Area vocational center	State-encouraged
Oakland, CA	School-within-a-school	State-encouraged
Pittsburgh, PA	Magnet high school	School district
Harrisburg, PA	Area vocational school	School

Responding to these recommendations, the state Division of Occupational Education Services outlined a continuum for occupational education and developed detailed curriculum units to be used by secondary schools statewide. The following courses must be taken before a student begins to study more specialized content:

Grades 7 and 8: (students entering Grade 7 in 1986 and thereafter)

- Home and Career Skills (3/4 unit required by end of eighth grade) --emphasizing decision making, problem solving, management, personal development, career planning.

- Introduction to Technology (1 unit required by end of eighth grade)--10 modules emphasizing technological systems, mathematics and science concepts, societal implications of technology, communications skills, safety and health, psychomotor skills, creative problem solving, and transfer of learning to new situations.

[Note that these two courses effectively do away with the old notions of junior high school "birdhouse" industrial arts and "apron and bib" home economics.]

Grades 9 and 10: (beginning with the class of 1989)

- Introduction to Occupations (1 unit required of all students planning an occupational education sequence to meet graduation requirements[2])--includes two required modules (Personal Resource Management and Working Citizen) with an additional two modules to be selected by the school or specific occupational program from among a total of 24 developed modules. Modules incorporate competencies in math/science, communications, problem solving, use of technology, and human relations/leadership.

Introduction to Occupations is intended to be a "bridge" between the junior high school occupational education requirements and the more specialized occupational programs that New York now encourages schools to reserve for eleventh and twelfth graders. A student who takes Intro to Occ (as it is familiarly called) in ninth grade might then proceed in the tenth grade to a one or two unit core course associated with an occupational cluster before selecting the specialty area within a cluster on which to concentrate during the last two years of school. Beginning in 1992, students following an occupational sequence will be required to pass a state proficiency examination on the two required modules of Intro to Occ. In addition, many occupational clusters already have or will nave state-developed vocational specialty tests for program completers. These assessments include both written and performance or laboratory evaluation components.

Ohio. The Ohio Plan is a set of options for the provision of vocational education that authorizes various combinations of vocational and academic instruction tied to variable levels of state vocational funding. All the options require a minimum of three hours per day of vocational shop or lab. They differ principally in terms of (1) whether or not vocational teachers also provide "related" instruction--that is, specific basic skills or employability skills--and for how long and (2) the amount of time that vocational students spend in academic classes taught by instructors certified in one of the core academic subjects.

Ohio high schools and joint vocational schools (as their area vocational centers are called) have not been required to participate in the options plan. However, many have chosen to do so. Probably the best known of these is the Great Oaks JVS in Cincinnati which has received national publicity on its efforts to integrate academic and vocational education, including a full length article in Smithsonian magazine. We chose to visit the Montgomery County JVS in suburban Dayton where in 1987-88, 28 of the school's 49 vocational programs required students to take one or more applied communications, math, or science courses taught by academically certified instructors. The school serves juniors and seniors from 27 school districts in five counties.

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[2] In addition to a required 13.5 units in core academics, the arts, and health, students in New York must complete various combinations of three and/or five course sequences in particular subject areas in order to earn a diploma. A five course employment preparation sequence in occupational education is one option available.

Under the options plan, Montgomery County JVS has developed an approach that requires academic and vocational teachers to work together in close cooperation. Vocational instructors remain in the classrooms during periods of academic instruction, often team teaching with the academic teacher. While they are not required to do so, academic teachers are strongly encouraged to spend time observing in both vocational classrooms and actual worksites in order to become familiar with the vocational applications of their subjects. Academic teachers work exclusively in a single vocational cluster. In most instances, applied curricula are being developed classroom-by-classroom as the program matures, with particular emphasis on making explicit to students the relationship between academic skills and their vocational program.

Oakland, California. The Health Academy at Oakland Technical High School is a replication of a school-within-a-school model of education originally developed in Philadelphia in the 1960s and successfully transplanted to California. The academy model specifically targets at-risk, disadvantaged, and underachieving students and is characterized by (1) strong business/industry involvement, (2) a "family" environment fostered by block scheduling that keeps a group of students together throughout most of the school day, and (3) opportunities for work experiences that clarify the relationship between schoolwork and real work.

In actuality, the Health Academy is an intensive, college preparatory academic/technical program with an applied emphasis. The program can accommodate a total of 150 students in grades 10 through 12. Nearly all the students accepted into the program have failed two or more classes in the ninth grade. Rather than "dumbing down" the curriculum for these at-risk students, the Health Academy considerably escalates expectations for them. Beyond the minimum graduation requirements for all students at Oakland Tech, Academy students take an additional unit of math, four additional units of science, and a half unit of computer education. In their senior year, students are eligible to participate in an advanced health occupations course offered jointly by the Health Academy, the Regional Occupational Program (ROP)[3] and Kaiser Hospital. This course involves one semester of academic preparatory training (laboratory, computer, medical terminology) and one semester of rotating, short-term internships in different departments of the hospital.

So far, the Health Academy has graduated one class. Of the 42 students who entered the program in 1985, 20 went on to the University of California at Berkeley or at Davis, 12 others planned to attend local community colleges, and seven took full-time jobs. Only one student failed to graduate. These statistics are certainly impressive; they are doubly so when one considers that all but one of the group entered the program scoring below the 50th percentile on the California Test of Basic Skills and with an average class rank at about the 30th percentile.

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[3] The ROPs are California's intermediate service delivery units for provision of vocational and technical training to multiple jurisdictions.

Pittsburgh, Pennsylvania. In 1983, Schenley High School in Pittsburgh became the site for three magnet programs--including a "high tech" program--under the city's voluntary desegregation plan. The high tech magnet program is an interdisciplinary, four-year curriculum emphasizing the integration of academic and technical content in teaching electronics. Students may opt for one of two strands: (1) a college preparatory "professional" program of studies or (2) a technical program intended to prepare students for postsecondary vocational training or entry-level employment. Operationally, there is relatively little differentiation between these two programs; the majority of students from both strands have gone on for further education.

In the high tech curriculum, English, math, and science courses are integrated with--in fact, driven by--the technical education sequence. English classes emphasize technical and business writing. Math and science classes have, with some difficulty, reordered content in order to synchronize with related skills needed in the technical labs.

Despite its promise, the high tech program at Schenley High School has had serious problems with student attrition, particularly with transfers of academically talented students to other magnet programs. Only 14 of the first entering class of 54 completed the program; this ratio improved somewhat for the second class which graduated 27 of 60 program starters. Among the second year group, 55 percent planned to enter four-year postsecondary institutions, four were headed for proprietary schools, three opted for the military, three were going to work, and two were undecided about their futures. Less than a fifth of these graduates, however, indicated that they would be pursuing further education in the electronics field.

Harrisburg, Pennsylvania. Dauphin County Technical School is a rare phenomenon--a comprehensive area vocational school, meaning that students who enroll receive all of their academic classes as well as their vocational education in the area center. The school enrolls about 800 students from six sending districts in grades 10 through 12.

Over the past six or seven years, Dauphin County Tech has been working on a radical restructuring of the education it offers students. The school has eliminated the traditional departmental structure in all areas of study and reorganized the faculty into four occupational clusters: technical careers, service careers, construction careers, and communication and transportation careers. Academic teachers are assigned to a specific cluster and work only with students in that group of programs, frequently instructing the same students for multiple years. The school uses a "week on/week off" schedule such that students concentrate on academics one week and their vocational courses the next.

Vocational education at Dauphin County Tech had been competency-based prior to the planning and implementation of the integrated curriculum approach. Gradually, competencies have also been developed for the academic courses as well. Like the high tech magnet program in Pittsburgh, the English curriculum at Dauphin County Tech focuses on technical report writing.[4] The social studies curriculum emphasizes the historical impact of work, workers, and industrial/technological advances, in addition to a good deal of emphasis on employability and independent living skills. Reportedly, alignment of the math curriculum with the vocational programs caused the least problem for academic teachers. Improved integration of the sciences with the various occupational clusters is a goal for the current school year.

The experiment at Dauphin County Tech was originally a five-year plan that has now been extended to 10 years. While they remain committed to the ideal that they set out to achieve, administrators and teachers alike have discovered that restructuring the relationship between vocational and academic education on a schoolwide basis is a massive undertaking. Evaluation of student outcomes has not been particularly rigorous. Pre- and post-testing of entering sophomores and exiting seniors using an instrument called the 3-R's test has found improved math scores but a decline in the language arts areas. The people we interviewed had no particular explanation for this trend, nor have their efforts been deterred by the lack of spectacular improvements in student achievement as measured by standardized tests.

Cross-site Themes and Issues

Clearly these five examples of efforts to better integrate vocational and academic learning are very different, both structurally and in terms of their conceptualization of the task. Nevertheless, we found in the course of our visits and subsequent reflection on what we had seen that several themes and issues arose consistently across all or most settings. In the pages that follow, we have organized our discussion of these topics under seven headings: Curriculum, Teachers, Instruction, Coordination and Support, Evaluation, "Regular" vs. "New Generation" Vocational Education, and Time.

Curriculum

Local curriculum development. Where schools are attempting to integrate applied academic content into--or coordinate it with--vocational programs, curriculum development is an important part of the planning and implementation process. In New York, as we noted in the program summaries, curriculum revision occurred at the state level. This, however, is the exception among the five sites. In the other settings, curriculum revision and alignment have occurred at the school or even the classroom level.

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[4] Examples of completed technical writing assignments from the Pittsburgh and Harrisburg sites appear as Appendix B to this report.

At Schenley High School in Pittsburgh, the curriculum for the High Technology Magnet Program was largely conceptualized by the program's first administrator, a former machinist who taught vocational machining for 20 years. This individual outlined what would be needed in the academic components and developed more thorough syllabi for the technical courses. Teachers and supervisors subsequently elaborated and refined course outlines.

At Montgomery County Joint Vocational School (JVS) in Ohio, slightly more than half of the vocational programs offered participate in the school's Applied Academics option. Nineteen of the programs require students to take applied math, 13 require applied communications, and 10 require applied science. There is some overlap in these figures; nine programs require both math and communications, and five require both math and science.

No formal curriculum development activities have accompanied implementation of the academic options program at the Montgomery County JVS. Instead, carefully matched two-person teams of vocational and academic teachers have devised new materials, problems, and exercises in the academic areas as they go along. The goal that is kept in mind constantly is to make explicit to students the links between their vocational training and academic content. In the classrooms where we observed, none of the instructors relied on textbooks. Rather, they were using teacher-made overhead projections, worksheets, group discussion exercises, and occasionally, bits and pieces of commercially published materials excerpted from a wide variety of sources.

The other area vocational school among our sites--Dauphin County Technical School in Pennsylvania--is also developing its integrated curricula in-house. Although the school's academic departments have been disbanded, subject matter specialists have continued to work together schoolwide to develop applied curricula. However, alignment of vocational and academic content occurs within the four vocational "clusters" that now represent the administrative structure of the school. We noted that in the service cluster at Dauphin County Tech, mathematics instructors appeared to rely more heavily on commercially published business math texts than was the norm in the other sites.[5] However, instructors did draw on a variety of these texts rather than a single series in an effort to identify problems and examples with the highest relevance for students' vocational interests.

Dauphin County Tech uses a competency-based approach to both academic and vocational content--as do the math, science, computer, and health occupations components of the Oakland Health Academy's program.[6] Vocational instructors at Dauphin County served as advisors to academic teachers on converting their courses to the competency-based approach. In Oakland, competencies are developed jointly by Academy staff, collaborating postsecondary institutions, and health industry partners.

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[5] The service cluster includes cosmetology, health assistant, marketing and distributive education, ornamental horticulture, and food production, management, and service programs.

Math and science curricula. While opinions varied among the sites about the ease with which particular academic content areas could be aligned with vocational programs, in general creating a match between math and science skills and occupational areas appeared to be easier and more straightforward than integration of English and social studies. This may be because math and science skills and concepts are more discrete and therefore come to mind in an applied context more readily than the uses of English or social studies.

In Schenley High School's High Technology Magnet Program, curriculum writers developed math/science/electronics matrices covering the entire electronics curriculum and then worked together to rearrange sequences in order to assure that students were learning the same concepts at approximately the same time in the school year. Beginning in the ninth grade, the sequences of math and science courses taken in the high tech program include Algebra I, Geometry, Trigonometry and Electricity/Mechanics, Pneumatics/Hydraulics, Advanced Pneumatics/Hydraulics. In addition, students in this program enroll in one or two periods of Tech Lab in each of their eight semesters of high school. Essentially, then, this is a college preparatory curriculum which, if successfully completed, would easily qualify a student for a state college or a community college program if not for MIT.

The Oakland Health Academy also moves its students through a college preparatory math/science program. Required science courses include biology, physiology, and chemistry. Some students may also take physics or advanced courses at an area college or university. Additional laboratory periods are scheduled for required science courses. Students begin the Academy math program at varying levels of proficiency. Although some students need considerable review of general math, most eventually complete pre-algebra, algebra, and geometry, each taught with an emphasis on applications to the health occupations. Capable students are encouraged to enroll in advanced algebra, trigonometry, and calculus.

At the other three sites, math and science were being integrated with a far greater variety of vocational programs. Under these circumstances, the process of integrating these subjects into specific occupational areas does not necessarily result in a course that one would recognize as Algebra I or General Math. Instead, teachers identify particular skills--whether mathematical, algebraic, or trigonometric--that are needed in order to complete vocational tasks and develop units of instruction that teach just those skills. Science courses emphasize the chemistry needed by medical laboratory assistants, the biology that will be useful to future farmers, or the physics concepts needed in the heating and air conditioning trade, for example.

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[6] Use of vocational competencies is, at this point, quite widespread across the country.

Two of our sites had purchased the commercially available applied physics curriculum called Principles of Technology (PT), developed by the Texas-based Center for Occupational Research and Development (CORD). PT is an intellectually rigorous two-year course of study that includes 14 units of instruction, each devoted to one physical principle as it is applied in the four energy systems: mechanical, fluid, thermal, and electrical. In general, PT appears to be mainly of use in the more selective vocational programs, such as electronics and related "high tech" fields, although Montgomery County JVS is using it with students in its various mechanics programs as well as the heating and air conditioning program and industrial drafting.

Teachers who have used PT report that it is rarely possible to complete the entire curriculum with any assurance that students have thoroughly understood the material. Therefore, as they become more familiar with the program, instructors tend to adapt the units to meet the applied science education needs of a specific group of students. Where there is articulation between high schools and a community college, students may begin the two-year PT course in high school and complete it at the postsecondary institution. The course is probably most successfully taught by an instructor trained in science, which eliminates many vocational teachers.

English/communications curricula. The sites we visited varied somewhat more in their approaches to integrating English with vocational instruction than they did in the math/science areas. In four of the programs there was a distinct emphasis on communications skills, by which the involved educators mean writing, reading, speaking, and listening competencies needed in the workplace.

Montgomery County JVS in Ohio has moved the farthest toward an applied communications approach that is significantly different from traditional high school English. The school's academic coordinator believes strongly that vocational schools and programs cannot take responsibility for remediating serious student deficiencies in reading. Thus, while the school does employ four remedial reading teachers, communications classes that are part of the Academic Options program concentrate heavily on occupationally related oral communications and writing skills, incorporating specialized reading vocabulary words as needed but not attempting actually to improve reading fluency.

We were particularly impressed by one communications class for students in the auto body program at Montgomery County JVS. This group of students--all boys--had been described to us as overtly hostile to the applied communications idea at the beginning of the school year. By all accounts, the English-certified communications teacher had experienced some extremely rough going, but with the complete support of the vocational shop teacher had never given up. Our visit was in May. When we entered the classroom, the boys and both instructors were seated in a circle, totally absorbed in a role playing exercise predicated on the following scenario:

> On a typical day in an auto body shop, the owner has gone on a fishing trip and left his employee, John Smith, in charge. Other employees include Larry, who works hard but is impatient; Curly, who does good work slowly and whose wife is nine months pregnant; Moe, who is a co-op student from the JVS; and Dan, the office manager and brother of the boss. There are two cars in the shop to be worked on. One belongs to Mrs. Spencer and the body work is finished, the painting half finished. The second belongs to Mr. Wellington, who is using the shop's "loaner" car; his own car needs parts that the shop does not have on hand.

Using some prompts from the communications teacher, the students spent an entire class period playing out this scene. Despite the presence of two observers, they were unself-conscious, motivated, and creative. The auto body shop instructor thoroughly enjoyed himself in the role of the absent Otto of Otto's Body Shop, calling on the telephone periodically to check on the work flow. As he occasionally glanced at the visitors, his face reflected the pride that he felt in his students who, he later told us, could never have expressed themselves as easily only a few months earlier.

It seemed to us that such an exercise was an entirely appropriate one for these students, several of whom already held afterschool jobs in their area of vocational interest. Incumbents of the various role playing parts demonstrated that they were thoroughly aware of important on-the-job communications skills such as taking complete phone messages, dealing tactfully with customers and suppliers, and handling temperamental co-workers with care. Furthermore, they had a grasp of critical life skills, such as health insurance coverage for the pregnant wife, that we are relatively certain would put most National Merit Scholars to shame! At this same school, the applied communications class associated with the Law Enforcement program emphasizes the observation, interviewing, and report writing skills that law officers and security guards must use frequently.

Technical writing has become the centerpiece of the English/communications curriculum at two of these schools. The recruitment brochure for Schenley High School's high tech program describes the English component of the curriculum thus:

> In addition to the standard objectives for each grade level, English classes in the High Tech Magnet include learning how to write precise directions and instructions, constructing flow charts and other diagrams, writing recommendation reports, feasibility studies, proposals, letters of application and resumes, and various other kinds of technical and business communications.
>
> Elements of short stories, poems, dramas, and novels will also be studied.

Thus, Schenley attempts to achieve a balance between the traditional high school English curriculum and what the high tech program planners conceived to be logical communications skills for students interested in following a technological career path. In the ninth grade, program participants are assigned a writing project requiring that they describe the nature and workings of a piece of equipment--preferably but not necessarily electronic.[7] Evaluation and grading of this assignment are shared by the electronics lab instructor and the English teacher. The final product is prepared in the computer lab using the keyboarding and word processing skills that students have learned in their required computer literacy course.

At Schenley, the English curriculum becomes increasingly oriented toward business and technical writing in the tenth through twelfth grades. Students write assembly and repair manuals, field reports, and other types of documents that are staples of the technological field. High tech English classes use "classics" of the science fiction genre to teach literary analysis skills on the theory that these books are of more interest to the students enrolled in the program.

Dauphin County Tech also centers its English/communications curriculum around technical writing. All students at the school are required to complete a technical paper about a shop or lab procedure that ultimately includes: (1) a cover page; (2) an outline of the contents; (3) an information sheet (the body of the paper); (4) a glossary; (5) a quiz based on the material presented; and (6) an answer key for the quiz. (See Appendix B for examples of completed papers.) As at Schenley, the papers are critiqued and evaluated by both the English teacher and the vocational instructor. Final products become part of the instructional materials for a given shop; the best of them may be used by vocational teachers to train other students in subsequent years. Some students who complete this assignment with relative ease go on to prepare a videotape for presenting the described procedure to peers.

Some English teachers are skeptical about the technical writing approach to an English curriculum. We heard strong reservations about it in Pittsburgh where some teachers believe that the magnet program curriculum requires students to write more with less to write about because of the lack of emphasis on works of literature containing "big ideas." Of course, an emphasis on technical writing does not necessarily mean that students cannot also be introduced to the literature that is part of our shared culture. At Dauphin County, we observed an English class where distributive education students were reading and discussing the play Our Town. The instructor deliberately reserves this particular piece of literature as a last assignment for graduating seniors because its central theme revolves around post-high school decisions.

The debate about what content vocational students will miss if the move toward English-as-applied communications becomes more widespread is likely to be passionate and will not be easily resolved. Some would argue that applied English courses represent the worst kind of tracking, depriving vocational students of exposure to common cultural traditions and information that will hamper their expectations and aspirations as adults. It is largely for this reason that the English curriculum offered by the Oakland Health Academy does not take an applied approach. Students in this program take a standard college preparatory English program that is taught by the Academy's director. She believes that for students headed for the health professions, good literature provides "a sense of compassion and the richness of human emotion" that is invaluable. Supporters of the applied approach counterargue that simply assigning classic literature is no guarantee that students will actually read or obtain meaning from exercises that they perceive to be irrelevant. In their opinion, the time can be better spent on helping students hone skills that are demonstrably useful in particular fields of endeavor.

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[7] Examples of completed technical writing assignments from Schenley and Dauphin County appear as Appendix B to this report.

Social studies. Only one of our sites--Dauphin County Technical School--included social studies among the subject areas to be integrated with vocational education. Elsewhere, program participants enrolled in regular history and civics courses, as required by their school districts. In some cases, because of the block rostering of students' schedules in other subjects, many participants do end up in the same social studies sections. However, there is no particular effort to align social studies content with what is going on in vocational classrooms.

In order to involve the social studies faculty in its total restructuring of the curriculum, Dauphin County has laid out a sequence of courses that stress the historical impact of work, workers, and industrial/technological advances. Classes also stress employability and independent living skills. In the tenth grade, students take a course on the impact of technological changes, using a text about the seven most important inventions in history. Eleventh graders enroll in "The World of Work" and one semester of economics, while seniors take psychology and family living.

New York's Revised Occupational Education Curriculum

The New York approach to encouraging better integration of vocational and academic education is quite different from what we found in the other four sites. First, all the planning and curriculum development activity took place at the state level. Second, academic subject supervisors and teachers were not initially involved, although they are gradually coming to be more active participants in the curriculum revision process. The state occupational education division has assumed the entire responsibility for revising the seventh through ninth grade occupational education curriculum to include a much greater emphasis on technological literacy and practical applications of academic skills. In addition, state curriculum writers have developed occupationally related mathematics and science courses that may count toward graduation requirements in these disciplines.

A full description of New York's new curriculum appears in the case study appended to this report. Here we offer illustrations of curriculum modules from the required junior high school course in technology education and the ninth grade course called "Introduction to Occupations." In a later section of this chapter, we describe our visit to a class of seventh graders on the day when they are launching model rockets. The rockets were developed as an activity for an Introduction to Technology module called "How People Use Technology to Solve Problems." Major concepts to be developed in this three to four week module include the following:

- There are formalized methods (systems) used to solve technological problems or make technological decisions.
- The problem-solving process includes design (planning) and implementation.
- An important part of the problem-solving process involves the generation of alternatives and the search for an optimal solution.
- Optimization of a solution normally requires trade-offs, in order to best meet the specified design criteria.
- Modeling techniques (e.g., drawings, computer simulations, working models, etc.) are useful problem-solving aids.
- Some problems cannot be solved by technology because of constraints imposed by scientific principles, resource limitations, and/or constraints resulting from people's values and attitudes.

The module identifies a number of instructional activities that teachers can use to help students understand these concepts. Nearly all emphasize a hands-on approach through projects such as the model rocket construction. In addition to the math, science, and communications concepts built into the activities, many are also designed to promote management skills, decision making abilities, interpersonal skills, and the ability to motivate other people on a team. As we point out in the next chapter, all of these skills are considered important by employers.

Twenty-six modules have been developed for the Introduction to Occupations course. Two are required (Personal Resource Management and Working Citizen); individual schools or even individual occupational education specialty areas may choose two other topics to complete the year-long class. One module available is "Basic Communications Skills." According to the syllabus, the skills, knowledge, and behaviors to be developed through this unit include the ability to:

(1) Use nonverbal elements to create effective communication
(2) Enhance listening skills and learn the difference between listening and hearing
(3) Improve study skills and the ability to read and follow directions
(4) Identify, locate, and use informational resources
(5) Prepare, proofread, and edit documents
(6) Use visual aids
(7) Make presentations
(8) Improve reading skills and apply these to work-related documents

In the reading section of the module, the focus is on skimming and scanning, understanding and interpreting charts, diagrams, maps and other types of schematics, and categorization of information. Writing activities include preparation and editing of essays on career-related topics, writing business letters, and filling out various kinds of forms and applications. This module, however, is one of many that schools may select; we have no idea whether or not it has ever been used.

National curriculum development. All of the sites we visited have worked extraordinarily hard on new curricula that blend or align vocational and academic components. In each setting, the energy to continue this difficult task emanated at least in part from the well-known "Hawthorne effect," that is, the mild euphoria of knowing that you are associated with an experiment that may result in an important breakthrough. However, if the curriculum integration initiative takes hold on a much broader scale, the hundreds of high schools across the nation cannot (and probably should not) be expected to engage in the intensity of curriculum development that we witnessed among these early innovators. Schools, districts, and states will want a place to begin, which suggests the need for published curriculum packages that can be purchased and then tailored to fit local circumstances.

Vocational education consortia such as the Center for Occupational Research and Development (CORD) and the Agency for Instructional Technology (AIT) are developing applied academic curricula that will be of use to schools seeking to integrate vocational and academic education. CORD's Principles of Technology course described earlier is one result; this curriculum, which is currently being revised and updated, is now used in an estimated 1200 schools in the United States and Canada. Last year, CORD embarked on development of an applied mathematics curriculum, principally for use with tenth graders. These materials are being field tested during the 1988-89 school year at 64 sites in 32 states. CORD's latest project--still in the early stages of development--is an applied biology/chemistry curriculum to be used primarily in conjunction with vocational agriculture, health, home economics, and technical programs. AIT is field testing and evaluating an applied communications curriculum in a number of school districts this year.

While these efforts are important and helpful, we believe that the demand for applied curricula will expand over the next decade. This is a new area for curriculum developers and there is much to be learned. Understanding this point, CORD has wisely built a curriculum revision stage into plans for its three applied courses on the assumption that pilot schools will have useful suggestions for improving the materials. Eventually, schools and districts will want choice in the applied curricula that they select--just as they now have with textbooks and materials for use in most classrooms. CORD and AIT rely on federal, state, foundation, and private sector support. However, if the market grows significantly, it is likely that commercial publishers will enter the arena; at that point, the movement can be considered institutionalized.

Teachers

Teachers are a critical factor in any effort to change the relationship between vocational and academic education. In the modal American high school, there is little or no professional communication between academic and vocational teachers; often enough, even social civility is lacking. Therefore, there is no readily available scaffolding for bridging the curriculum gap. Building such a construct has been a major part of the planning and implementation phases in four of the five sites that we studied--and it is painstaking work.

Creating better channels for communication--and ultimately a better articulated curriculum--is most effective when both vocational and academic teachers are committed to the idea. Currently, the burden of "unfreezing" the status quo seems to be falling disproportionately on vocational educators. We did not see and have not heard of any instance where the English department or a group of math teachers has suddenly thought, "Gee, we should go along and see how we can coordinate our lessons with what the shop teacher is doing." On the other hand, when the idea of curriculum integration is proposed to them, many academic teachers become enthusiastic about the possibilities.

Staff assignments. The programs we visited have different philosophies and use different strategies for involving teachers in an innovative approach to curriculum and instruction. For example, all eight teachers who are part of the Oakland Health Academy volunteered to participate. In contrast, all 11 teachers involved in Schenley High School's High Technology Magnet are assigned there by school and program administrators.

At Montgomery County JVS, the academic coordinator spends a great deal of her time finding academic teachers who understand and are sympathetic to the team teaching/applied content approach that the school's Academic Options program embraces. Once she has found somebody, she commits equal energy to creating optimum matches between the vocational and academic instructors who must work together so closely, often moving the academic teachers around in search of a perfect fit. The JVS has not tried to force the options concept on all vocational programs or teachers. None of the Business and Office Education programs participates and the Home Economics program has been inexplicably hostile to the whole idea.

When Dauphin County Technical School disbanded its academic departments and reorganized all faculty into clusters, academic teachers were assigned to one of the four vocational areas by fiat. Despite this rather peremptory approach, no changes in team composition have been requested in the first five years of the innovation. Six teachers have voluntarily left the school as a direct result of the changes in organization and curriculum, however.

In New York, the statewide curriculum revision affects all junior high school occupational education teachers and a good many at the high school level as well. All teachers certified in industrial arts and in agriculture are eligible to teach the new Introduction to Technology course and certified Home Economics teachers may teach all modules of the new Home and

Career Skills curriculum. In addition, teachers certified in science, business education, health education, and guidance may teach certain units of these required junior high school courses.

In New York's senior high schools, all teachers certified in an occupational education subject are eligible to teach the two required modules of Introduction to Occupations. However, the 24 elective modules must be taught by specialists in various occupational fields, as appropriate to the content. The optional occupationally related math and science curricula developed by the state may be taught by academically certified teachers or by a degreed occupational education instructor who can demonstrate at least six semester hours of college math or science.

The question of who is qualified to teach the academic content in these integrated programs is an important issue. Many vocational teachers will assert that they have been teaching "related" academics in their shops and labs for years and see no particular reason for working more closely with their academically certified colleagues. One vocational teacher whom we interviewed in Ohio is participating in the options program with the greatest reluctance. While she believes that communications and mathematics skills are important for her students, she feels that these areas were adequately covered under the old system of related classes. Academically certified teachers, in her opinion, will not necessarily have a good handle on appropriate examples to use with students in particular occupational programs. Other vocational teachers, however, freely admit that, while they can personally use mathematical skills effectively in their trade or profession, they do not necessarily know how to impart this knowledge to their students.

We believe it is significant that, in four of our five sites, academic and vocational instructors continue to be principally responsible for teaching the material in which they have the most expertise. Math teachers teach math, science teachers teach science, and cosmetology teachers teach cosmetology. The real differences in their professional orientation are an increased awareness of how their field relates to others and greater sensitivity toward ways of helping students understand the interconnectedness of learning.

In many ways, this is the most difficult approach because it requires changes in the mindsets of two very different groups of teachers. It is not just a question of qualifications on paper. For example, teaching communications, math, or other academic skills and concepts in an applied fashion requires a different way of thinking about academic content. Vocational teachers at one site talked about having to get teachers to "think the shop way." This phrase is not clearly defined but, again using math as an illustration, seems to refer to skills in estimating and problem solving on the fly. Not all academic teachers can successfully make this transition, even with considerable support and encouragement. In fact, an award winning English teacher may be a poor instructor of applied communications just as a brilliant theoretical mathematician cannot necessarily present knowledge in a manner that is meaningful to draftsmen, engineers, or machinists who could make use of it. The bottom line is that staff assignments are critical variables in the equation when the issue is restructuring the relationship between academic and vocational education.

Staff development. Staff development has been an important tool for creating and sustaining change at all five sites in our sample. In Ohio, the academic coordinator at the Montgomery County JVS has control over uses of the school's federal Chapter 2 block grant funds, which amount to about $10-12,000 annually. Based on a yearly needs assessment conducted by a faculty committee, she invests these funds in staff development activities that support progress of the Academic Options program. In recent years, some areas addressed have included (1) training teachers in the techniques of evaluating student writing holistically; (2) approaches to peer observation, designed to help break down the barriers between academic and vocational teachers; (3) a writing course for vocational instructors; and (4) a program emphasizing ways to raise student achievement through instructional strategies such as judicious distribution of teacher praise and the use of questions that call on higher order reasoning skills.

State occupational education administrators in New York realized early on in their curriculum revision effort that the implementation stage in their reform effort would require massive staff development. Consequently, they identified and trained a cadre of teachers and supervisors who could in turn providing training and technical assistance to their colleagues across the state. One supervisor who is directing part of this inservice effort estimates that perhaps 60-70 percent of the state's high schools are implementing the new curriculum as it had been conceptualized. This suggests that staff development efforts still have some way to go.

The curriculum development activities that teachers undertake in several of these settings should really be considered staff development. Many teachers retire without ever having struggled with developing or revising curriculum in their own area of expertise, never mind trying to work with other teachers to integrate and align multiple subjects. Montgomery County JVS, Dauphin County Tech, the Schenley High Tech magnet, and the Oakland Health Academy have all required teachers to be actively engaged in rethinking the curriculum. Dauphin County provided some formal inservice training in the planning stages to help its staff grapple with developing competencies for the academic areas. Oakland has been able to pay teachers to work on curriculum during the summer months.

Another strategy that should be considered staff development in these programs is the establishment of mechanisms for regular meetings between academic and vocational teachers. At Schenley, these are called "roundtables." Dauphin County schedules cluster meetings that, at least originally, were modeled on the idea of quality circles in business and industry. Officially, such meetings provide a forum for discussion of specific issues regarding curriculum integration and problems to be resolved. The hidden agenda--particularly at the outset--is planned opportunities for academic and vocational staff to become better acquainted.

Finally, nearly all of the programs encourage or create opportunities for both vocational and academic teachers to observe in each other's classrooms and/or to visit work settings that are representative of situations where their students may some day be employed. These strategies are intended to broaden the instructors' perspectives and suggest activities for applied learning that can be incorporated into syllabi and lesson plans. Since these observation opportunities are usually not required, some teachers never participate. Many do, however, and find them to be a wonderful source of ideas.

Creating a supportive environment. Teachers--both vocational and academic--need a great deal of support and encouragement, as well as more tangible incentives, in order to sustain their commitment to an innovation. There is nothing surprising about this conclusion; it is an observation that has become a staple of research on organizational change. In schools, as in all other organizations, the natural condition is a comfortable stasis. Change, on the other hand, is hard work and often stressful. Given an opportunity to innovate, many teachers--probably the majority--would turn down the offer.

The sites that we visited relied largely on committed leadership to sustain interest in the innovation. The leaders themselves used various forms of encouragement with teachers: well-constructed professional development programs, stipends for teachers who accepted additional responsibilities, release time for planning and curriculum development, and (probably most important of all) generous measures of understanding to counteract apprehensions or frustrations. We came to think of the individuals who kept these programs on track as "heroes," although their common characteristic was not so much charisma as dedication.

The Oakland Health Academy is probably the clearest example of overachievement in the leadership role. In addition to her skill at juggling many balls simultaneously, her talent for fund raising, and her responsibility for teaching the Academy English classes, the director of this program pays a great of attention to the needs of other staff. For her, "management" consists of locating special materials, equipment, and supplies for the innovative things that teachers want to do, helping teachers adapt their teaching styles to student needs, and ensuring plenty of positive recognition for a job well done. It is not uncommon for her to cater a dinner for participants at the end of an in-service education session.

In Pittsburgh, maintenance of a supportive environment seems to become the responsibility of the "glue person," i.e., a single participating educator who takes charge of ironing out the problems and making the arrangements that no one else seems to have time or energy for. Presently, the glue person is the instructor who teaches high tech computer literacy but also does a great deal more for the magnet: arranging field trips, encouraging students to submit their work in contests, setting up teacher teaming activities to encourage cross-fertilization between the academic and vocational teachers, and generally serving as the program's committed advocate.

Each program has someone like this. In New York, it has been the director of the state Division of Occupational Education who orchestrated a massive planning and development effort and is currently overseeing statewide implementation of the new occupational education curricula. At Dauphin County, the curriculum coordinator has been the low key but steady and consistently positive support system for the faculty of an entire school. The efforts of the academic coordinator at Montgomery County JVS to nurture (but not force) new professional relationships have been described earlier in this section. Philosophies, approaches, and personalities may differ. The goal--nourishing enthusiasm--does not.

Instruction

Organization of instruction. In the sites we visited, approaches to organizing instruction for the newly integrated vocational and academic curricula varied. Among the configurations that we observed are the following:

(1) At one area vocational school, applied communications and mathematics classes are taught by academically certified teachers while the vocational instructor remains in the room as a resource.

(2) At another area vocational school, all academic teachers are assigned to a specific vocational "cluster" and coordination of instruction is planned in regular cluster meetings.

(3) In New York, a new statewide occupational education curriculum places greater emphasis on basic skills and problem solving but is just beginning to involve academic instructors in program implementation.

(4) The two high tech programs that we visited are essentially self-contained units within a larger setting. Teachers associated with the programs form a team and students move through the bulk of the school day as an identifiable group through a scheduling device called "block rostering."

(5) In at least two of the programs, students are likely to have the same teachers for academic subjects for multiple years. Instructors in these settings believe that this strategy is particularly effective with students who are hostile toward school or who have low self-esteem. Teachers are able to (1) develop stronger personal relationships with individual students and (2) identify and work on academic weaknesses more consistently over a long period of time.

We are not in a position to say that one or another of these approaches seems to work better than others. We were intrigued by the team teaching strategy at Montgomery County JVS. Several of the teaching pairs whom we observed were doing an outstanding job of engaging the attention of average or below average students in the real-world applications of their academic studies. Similarly, based on these visits as well as previous work in vocational education, we are convinced that the school-within-a-school concept (represented here by the Oakland Health Academy and Schenley's High

Tech magnet) is one of the most promising models for increasing the educational success rates of at-risk students in large comprehensive high schools. At the same time, we are concerned about the lack of involvement of the academic side in New York's efforts; in our view, upgrading occupational education curricula alone will do little to change attitudes about vocational education in the broader educational community. It is our understanding, however, that other changes are under consideration in New York that may blur the currently black and white distinctions between academic and occupational education "majors."

Higher order thinking skills. From the outset of this study, we have been clear in our own minds that the educational potential of integrating vocational and academic education goes well beyond the reinforcement of basic skills. Furthermore, as we document in Chapter III of this report, the "basic skills" that employers are currently talking about bear little resemblance to the minimum academic competencies that most states now use as the yardstick for educational accountability. The marketplace demands employees who can think, solve problems, troubleshoot, and communicate by situation rather than by formula.

On paper and in conversation, every educator in every program associated with this study articulates a commitment to teaching students thinking and problem solving skills. But what happens behind the classroom door? Do teachers really know how to do what they would like to do? We are happy to report that in these sites, the answer to this question is frequently (although by no means always) "Yes." Here are a few illustrations from our classroom observations.

> In a math class for students from a carpentry program, a math teacher reviewed the concepts of slope and pitch. Formulas are involved and the students continue to confuse them. For example, pitch is rise over span and slope is rise over run, which is half a span. In order to reinforce the concept of a ratio, the teacher makes reference to an article on compression ratios in a recent Car and Driver magazine. This is obviously an application that students can relate to and the lesson proceeds smoothly to other uses of ratios such as installing downspouts and constructing decks, jobs that the teacher knows some of these students will hold during the summer. For extra credit, she poses a real problem connected to her own summer project--a terrace in her backyard. If the area that she needs to fill with dirt is so many cubic feet, how many pounds of topsoil will she need to buy? Working alone or in small groups, the students begin to figure this conversion problem out.
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> A seventh grade technology class was preparing to launch the model rockets that they had been working on for several weeks. The objective of this unit is for students to understand the parts of a "system," in this case the fins, body, etc., that make up the vehicle. Outside on the athletic field, the students pretended not to care whether their particular rockets had a good flight or not. However, as various flights fizzled, there was much

> speculation about causes. "I think it was because of the wadding," said one boy, implying that he would like to remove this component from his model. The teacher reminded him that the wadding is necessary to keep the parachute from burning during launch and considered the next theory. In short, this class was engaging in scientific hypothesizing.
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> In an economics class for students from service occupations programs, a teacher reviewed different types of taxes--progressive, regressive, proportional, tariffs, etc. At one point he prodded students to come up with reasons for imposing a tariff since it raises relatively little revenue. When dead silence ensued, he refused to fall into the trap of answering his own question but instead led students by logic to the realization that "it protects our jobs." At another point in the discussion, he asked why the state would give the German-based Volkswagen company a tax break on establishing a new plant. Again through skillful questioning, the students discovered the answer for themselves--to increase opportunities for employment.

A cognitive psychologist could probably analyze transcriptions from classes such as these and tell us precisely what cognitive skills were being developed or applied. For us, two things stood out in these and other classrooms that we visited. First, teachers were actually engaged in an instructional dialogue with students. It may not have been exactly a Platonic dialogue; nevertheless, it was sufficiently different from either a lecture format or routine, passive seatwork to be striking. Second, either by instinct or because they had learned how from some professional development activity, teachers were using probes and questions that caused students to reflect, to draw on previous knowledge, and to ask questions of their own. In other words, students were thinking in order to solve problems.

Of course not all the classrooms that we visited were this dynamic, which is really the point. The good intentions of the programs and well-articulated curricula cannot do it all. At some point, goals, materials, and teachers intersect and it is the teachers who are variable--in terms of pedagogical skills, in terms of attitudes, in terms of creativity, in terms of relationships with students, and in terms of their ability to demonstrate to students what the thinking process entails. In short, students are likely to continue to have a mixed bag of instructional experiences in even the best constructed, most appropriately challenging programs. This has always been the case. A particular strength of most of these programs is that the classroom doors are open more of the time in the sense that teachers are interacting with and thus learning from each other. Someday, all teachers may know how to model higher order thinking skills for students.

Coordination and Support

The success of the five programs discussed in this study has been variably dependent on coordinating assistance and support--financial, facilitative, or moral--from a number of sectors. While vast new resources do not appear to be necessary in order to undertake a local effort to improve the integration of vocational and academic education, four of the five programs that we visited relied on special "pots" of funding for such activities as planning, curriculum development, inservice training for teachers, or improvement of articulation with a local college. The fifth site--New York state--has invested a large amount of time, money, and personnel in its statewide curriculum revision effort. In addition, some programs have received inspiration, conceptual assistance, and/or technical assistance from another bureaucratic level of the educational hierarchy, e.g., Schenley's relationship with district level vocational educators.

Federal support. To the best of our knowledge, only two of the programs studied have used federal funding in planning or implementing their curriculum integration efforts. As noted previously, Montgomery County JVS uses its Chapter 2 block grant funds (approximately $10-12,000 annually) for professional development activities that directly benefit teachers who are participating in the Academic Options program. For four years, Dauphin County Technical School received about $40,000 annually in state-administered Perkins funds for vocational curriculum development. However, the school was recently denied a fifth year of funding from this source. Dauphin County used this money for inservice activities, updating books and materials, and stipends to the teachers who serve as cluster managers (a role that requires overtime beyond normal contractual hours).

State support. The impetus for innovation originated at the state level in three of the programs studied. We have already had a good deal to say about the curriculum development and implementation stages of New York's revision of its occupational education curricula. Documentation of the need for and conceptualization of the undertaking also came from the state Division of Occupational Education. A 1981 decision to review the status of vocational education in New York was predicated principally on state educational leaders' perceptions that the mission of vocational education was badly in need of redefinition to fit the changing social and economic contexts for education and work. In order to determine the parameters of a new mission, the Division initiated a three-year Futuring Project involving hundreds of business representatives, educators, and students across the state. The results of these hearings fed into committee work that in turn resulted in recommendations on which to base curriculum revisions. Throughout these and subsequent stages, the state designed, orchestrated, and monitored the change process.

The Montgomery County JVS developed its Academic Options program because Ohio's state department of vocational education authorized a set of vocational program configurations that serves as an incentive to local districts interested in redefining the relationship between vocational and academic education. The options policy allows districts to choose among several scheduling patterns for vocational laboratory periods, related vocational instruction periods, and periods of applied academics without loss of state vocational funding. Thus, with no increase in its own budget, the state has signalled to the localities that it is interested in seeing them try innovative approaches and will support experimentation. This seems to us to be a highly workable strategy that many states could employ.

In California, the Oakland Health Academy obtained start-up funding from the state under legislation that provided seed money for the planning and initial implementation stages of local efforts to replicate the successful Peninsula Academies, which in turn were replications of a model developed in Philadelphia in the 1960s. An initial six-month planning grant of $25,000 was followed by implementation grants of $50,000 annually for three years. Now the program is eligible for $67,500 per year in state funding but must meet certain performance standards--including an 80 percent attendance rate and evidence that at least 58 percent of the students are passing 90 percent of the credits they attempt.

District and school support. The two area vocational centers among our sites are essentially school districts in their own right. Dauphin County Technical School administrators made the decision to abandon academic departments and go to a schoolwide vocational cluster organization on their own, with the approval of the school board. Montgomery County JVS' decision to take advantage of the options alternative was spearheaded by the school's superintendent and its director of Pupil Personnel Services but involved administrators and counselors from several "sending districts" as well. The JVS adopted this more inclusive decisionmaking strategy in order to ensure that an increased emphasis on academics would not be perceived as "infringement" by the feeder districts that could be in a position to dissuade students from attending an area vocational program.

The idea for a high technology magnet program in Pittsburgh originated with an associate superintendent of schools as part of a larger set of voluntary initiatives to achieve racial balance. This administrator based his rationale for a high tech program on a study of skill training needs in area businesses. The planning stage for the program involved the associate superintendent, the district's Director of Occupational, Vocational, and Technical Education, other administrators, and teachers. Development and implementation of the program then passed to the school level.

Both Schenley High School's High Technology Magnet and the Oakland Health Academy are small parts of a much larger setting. This fact has had different ramifications for the two programs in terms of supportiveness. Schenley has several special magnet programs designed to attract white students to the school. According to program administrators, each year a relatively large number of students are recruited away to other magnet options such as the International Studies program for academically talented students. Since these students stay in the school, racial balance figures are not affected. Supporters of the high tech program believe that, to some extent, they are still fighting a stigma problem; despite a rigorous curriculum and a new name, the program continues to be viewed as vocational education, however much enriched, and therefore is not appropriate for students with college potential.

In contrast, the Oakland Health Academy is a prized part of the offerings at Oakland Technical High School. The school's principal is an enthusiastic supporter who provides any administrative backup needed to assure the program's success. He works with the program's director to minimize any resentment of the Academy's special status among nonAcademy staff and has helped to break down resistance among a few reluctant teachers assigned to teach Academy classes.

Private sector and community support. Each of the five sites in the study has enjoyed some private sector support, principally in the form of advice from business and industry on the academic skills and competencies that particular employment sectors find desirable. At Schenley High School, private employers, particularly those serving on the high tech program's Advisory Committee, have donated equipment, provided speakers, and provided opportunities for teachers to observe in the workplace as an aid to curriculum development. The active role that business and industry played in New York's "futuring" process has been mentioned previously in this analysis.

Among the sites, the Oakland Health Academy has had, by far, the greatest amount of private sector support. This is largely due to the entrepreneurship of the program's director and is illustrative of the endless possibilities for partnerships when a determined person takes charge. From day one, the Academy has had joint ownership. The decision to apply for a state replication grant was made by the Superintendent of Schools and the Oakland Alliance, an organization of leaders in higher education, business, and the public schools. The Alliance served as a "broker" in the early phases of start-up, bringing together the various parties, organizing the Steering Committee, and scheduling the planning meetings before gradually fading out of the picture as the program became established.

Over a four-year period, numerous organizations and institutions have contributed to the Health Academy's success through, for example, in-kind donations of supplies, equipment, staff time, and expertise, by mentoring students, and by providing internships or job placements. This year a local college is offering introductory courses at Oakland Tech for concurrent high school/college credit. In addition, the program receives ongoing support from the American Red Cross, the YMCA, and the Kaiser Hospital/Foundation.

The Health Academy has also been successful in attracting a considerable amount of supplemental funding from private sector and community sources. It currently has a three-year $165,000 grant from the California Academic Partnership Program (CAPP) to develop cooperative efforts between Oakland Tech and the Samuel Merritt College of Nursing. The Center for Living Skills, a local organization that conducts leadership training, is donating time to conduct its program with Academy students, matched by a total of $17,000 in funding from the Kaiser Foundation, the Clorox Foundation, and City Corp.

Evaluation

As with most educational programs, useful information about student outcomes that can be directly tied to participation in an innovative program is a scarce commodity at the sites we visited. Of the four school-based programs, the Oakland Health Academy has been the most stringently evaluated. Baseline and follow-up data on student achievement, grades, attendance, and earned credits at this academy and the other state-funded replications have been gathered by independent researchers under a contract funded by Hewlett-Packard. The data show that the average Health Academy student gains two-year's growth annually in reading and math skills while in the program. Other indicators of program success include improved attendance, more credits accumulated, higher grade point averages, fewer courses failed, and a lower probability of dropping out of school.

The Health Academy is particularly proud of its college placement rate. In 1987, only 44 students from the entire Oakland School District were accepted by the University of California system. At the time of our visit in the spring of 1988, 20 students from the Health Academy's first graduating class had been accepted by UC campuses.

Long-range evaluation of the Oakland Health Academy has shifted to the Far West Laboratory (FWL), a federally funded research entity. FWL will document students' academic achievement, changes required of teachers by the academy concept, the potential adaptability of the program to other settings, and linkages between the program and other organizations.

New York is moving toward a state proficiency examination based on its ninth grade course "Introduction to Occupations," required of all students who plan a vocational concentration (or "sequence") to meet state graduation standards. This requirement goes into effect with the class of 1992. In addition, the state will shortly offer a state examination in technology education, and several occupational clusters will have exit assessments that may include both written and performance evaluation components. This network of tests is designed to serve as an accountability system for occupational education throughout the state. When the system is totally in place, schools will submit results to the state and receive in return a Comprehensive Assessment Report comparing a school or district's outcomes with others in their region and statewide.

While the longer term effects of New York's occupational education curriculum revision on student course taking and postschool outcomes will not become apparent for a number of years, early evidence suggests that at least some elements of the new approach are taking hold. For example, there has been a dramatic increase in enrollment in the occupational education courses that carry academic credit--nearly 40 percent in one year.

The Montgomery County JVS primarily relies on standardized achievement test scores to assess the impact of the Academic Options program. Apparently as a result of their participation in applied academics classes, achievement test scores in reading and mathematics for students in the auto body program, for example, moved from far below average to close to the median. Scores for welding students moved from the mid-range to the top quartile. The JVS emphasizes a developmental writing program for all students. Whether or not their particular vocational program is participating in the options program, each student is assigned 18 writing tasks each semester, including four essays. The goal is to have each student increase one full point per year on a holistic writing evaluation scale that ranges from a low of one to a high of seven. In recent years, on the average, students improve about three-fourths of a point in the junior year and a full point in the senior year. JVS faculty are understandably proud of these statistics.

There are no special evaluation methods employed to assess the education outcomes of Schenley High School's High Technology Magnet Program. Participating students must pass the "MAP" (Monitoring Achievement in Pittsburgh) tests required of all high school students in the city. To some degree, this colors or constrains the curriculum development efforts of the high tech program. Beyond this, however, the chief evidence of program success is measured by student-reported post-graduation plans. Of the 27 students expected to graduate in 1988, 15 were planning to enter a four-year college. An additional four were enrolling in a postsecondary proprietary school, three were entering the military, three were going to work and two were undecided. This adds up to a total of over 80 percent who had plans that were likely to lead to further education or training in some field, if not in the electronics specialties that their high school program had emphasized.

Overall, we were disappointed by the lack of documentation of success that these efforts to integrate academic and vocational education were compiling. If the programs believe that what they are doing makes a significant difference, then they have a responsibility to offer some systematic proof of that difference. In order to validate the effectiveness of applied academics, monitoring and evaluation of student progress must become important components of innovative efforts. This will require more than standardized or minimum competency testing. Perhaps the most important outcome should be whether students are able to use what they know in practical situations, which may require new forms of assessment. Other important outcomes that may be challenging to measure include changes in attitude toward education and in self-esteem.

Traditional vs. "New Generation" Vocation Education

As a result of our research for this study, we have observed that vocational education appears to be increasingly developing a two-track system. On the one hand, there are the traditional vocational programs--for example, Trades and Industry, Agriculture, Home Economics, Business and Office, Distributive Education and Food Services. On the other hand, there are the "new generation" vocational/technical programs--with the emphasis on technical--that stress preparation for careers in electronics, computers, medical technology, drafting and design technology, etc. The latter programs are typically more selective, more academically rigorous, and, if responsibly implemented, make it clear to students that they will need education and training beyond high school to succeed in the field. In essence, they are a new type of college preparatory program.

In terms of a movement to achieve better integration between vocational and academic education, this dichotomy disturbs us. Integration is often more visible, considered more "exemplary," and possibly is easier to implement in the new generation vocational programs. However, there is probably greater need for better curriculum alignment in the traditional programs, which tend to attract students with more academic deficiencies and/or a more negative attitude toward the utility and importance of education. Overall, we were as impressed with the accomplishments at Montgomery JVS as we were with the new generation specialty programs at the Health Academy and the High Technology Magnet. The challenge of taking an auto body class from hostility and inarticulateness to enthusiasm and verbal fluency is not a less worthy goal than preparing underachieving disadvantaged students for careers in the health professions. Society still needs auto body shops as well as medical technicians.

In a few states (notably New York and Virginia), a generalized technology education course is replacing the old industrial arts program as a required part of the junior high school curriculum. Such programs emphasize systems, math and science concepts, communications skills, creative problem solving, and the transfer of specific learning to new situations. In New York, as we have described, the required junior high school home economics curriculum has also been revised to emphasize decisionmaking, problem solving, and personal management issues. These curricula, by design, make deliberate connections between students' academic learning and practical, hands-on applications of that learning that make sense to adolescents. We believe that this is an entirely appropriate approach. This is a post-industrial, technological society and all students should be exposed to the implications and utility of technical discoveries and applications. The caution we offer, however, is that not everybody can have a "high tech" career. Ample opportunities for thinking and problem solving will continue to exist in jobs more closely related to traditional vocational programs for the foreseeable future. Applied academics and curriculum integration must therefore be a priority across the vocational education sector.

The broader point to be made here is that in all secondary school programs--including traditional vocational education programs--the emphasis should be on education, not training. At a minimum, students should emerge from their high school experience with the expectation that they can learn and that it is desirable to continue to learn, whether on the job or in a formal educational setting. The realities of the workplace in the late twentieth century no longer allow the fantasy that high school completion is a terminal educational goal on which a solid and secure adulthood can be built. Rather, high school is an enabling experience that allows students to make post-graduation choices. Students who respond better to hands-on or applied approaches to learning should finish with the same short- and long-term choices as other students, including further education or training that does not have to begin with remediation.

Time

As the discussion in other portions of this chapter suggests, the process of creating improved integration of vocational and academic learning takes considerable time. We cannot overemphasize this point. The educators who are developing new integrated and applied approaches to secondary school curriculum and instruction have no formulas or guidelines to follow. They are learning as they go. Prior to implementation, there is a necessary planning stage. Then, in all cases, it takes a minimum of three or four years before the first class of participating students completes a full program cycle and a realistic assessment of program impact can be made. Program corrections, adjustments, and adaptations require further time. Finally, the most basic issue of lowering the attitudinal (and often the physical) barriers that have separated vocational and academic teachers for over 70 years is a factor that knows no time limits.

Every one of the programs discussed in this study is at least four years old. New York began its futuring process in 1981; by the time the first graduating class of occupational education students is required to pass a competency test on the required modules of Introduction to Occupations in 1992, a full decade will have passed--10 years of planning, development, and implementation activities. What was initially a five-year plan at Dauphin County Tech is now a 10-year plan. Other sites have set no time limit on their efforts and, indeed, have no clear picture of precisely what their programs will look like when they are fully mature. In reality, the process of innovation in all of these projects is, appropriately enough, a systems loop that allows continuous adaptation, modification, and improvement of a program. There is no beginning and no end.

Summary

We discuss specific conclusions and some implications of those conclusions in some detail in Chapter IV of this report. Here, let us simply say that our overall impression of these five efforts to change the relationship between vocational and academic education is positive. The educators involved are grappling creatively with a structural change in education that goes far beyond the cosmetic layering on of new graduation requirements or minimum competency tests--typical state and local responses to calls for academic reform. It is exactly because the change envisioned is structural that the process is so complex, incremental, and lengthy. Furthermore, there is no blueprint against which to check progress on the road to completion. Given this level of ambiguity, we found these sites to be admirable in their persistence and in their willingness to be pathfinders. Their groundwork will be of immense utility to other states, schools, and districts, for we believe that the re-examination of traditional curricular and instructional relationships is a reform that should and will grow.

We turn now to a brief review of several literatures that helped us frame our thinking about the relationship between academic and vocational education.

CHAPTER III

What Skills Do People Need?

In this chapter, we examine (1) various definitions of prerequisite general cognitive and/or academic skills that may be important to successful functioning in work and in life and (2) the research that has been undertaken to determine how people learn and apply these skills. We wondered what, if anything, research could tell us about how one develops the types of cognitive skills and mental capabilities that would be assets in the marketplace. Can they be taught? Can they be taught in school? If they are taught outside a specific application context, can they be transferred? Is there any research evidence that vocational education can successfully serve as a bridge or translator between academic learning and the real world applications of that learning? The short answer to this last question is "No." Cognitive research has not thus far examined vocational education as a vehicle for teaching skills of any type. Nevertheless, we found aspects of the existing literature useful in furthering our own thinking about the issues related to integrating vocational and academic learning.

Skills for Work and Life

The employer's point of view. Precisely what skills do people need in order to lead successful and productive lives? Many groups have offered lists in recent years. For example, the College Board brought together 200 business leaders and educators in five cities to discuss academic preparation for the world of work. The business leaders agreed that academic competence is an essential ingredient in success on the job. Their nominations for a critical academic skills list included the following:

> Reading--the ability to read and follow instructions, to acquire a vocabulary related to business, industry, and the economy, to read for a specified purpose, and to read visuals, graphics, charts, and schematics.
>
> Writing--the ability to express ideas accurately, succinctly, legibly, and with correct spelling.
>
> Speaking and listening--awareness of the importance of tone of voice, attitude, and body langauge as well as the ability to use standard English, organize and present one's thoughts orally, and formulate good clarification questions.
>
> Mathematics--the ability to estimate, apply the results of estimation, interpret results, and understand consumer economics and mathematics.

Reasoning--the ability to understand how decisions are made, to consider alternative actions, to recognize causal relationships, to determine what action is appropriate in a situation, to evaluate the outcomes of the action, and to change or adapt behavior accordingly.[1]

In terms of communications skills needed in the workplace, the U.S. Department of Labor has developed a six-point scale for rating the language-related skill requirements of jobs:

Level 1:	reading vocabulary of 2500 words; reading rate of 95-125 words per minute; ability to write simple sentences (laborers)
Level 2:	reading vocabulary of 5000-6000 words; reading rate of 190-215 words per minute; ability to write compound sentences (transport workers, farmers)
Level 3:	ability to read safety rules and equipment instructions; ability to write simple reports (administrative, service occupations)
Level 4:	ability to read journals and manuals; ability to write business letters and reports (technicians, management)
Level 5:	ability to read scientific/technical journals and financial reports; ability to write journals and speeches (engineers, lawyers)
Level 6:	same skills as for level 5 but more advanced (natural scientists)

Using projections about job growth sectors and the results of a special NAEP survey of young adults, the Hudson Institute estimates that of the expected 25 million new jobs expected to be created between 1984 and 2000, 40 percent will require language skills at Level 4 or above and 58 percent will fall between about 2.5 and 3.9. According to NAEP, the average skill level of a representative sample of 21-to-25-year-olds is 2.6. In other words, the kinds of skills that high school students and fairly recent graduates seem to master will be of little utility to them in the growth sectors of the job market--yet another indicator of the mismatch between our educational system and the world of work.[2]

Very recently, the American Society for Training and Development (ASTD) issued a report on workplace "basics" that names a number of skills employers want. They include:

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[1] The College Board. "Academic Preparation for the World of Work." New York, NY: Author, 1984, pp. 2-4.

[2] Arnold Packer. "Retooling the American Worker." The Washington Post, July 10, 1988, Section C, p. 3.

- knowing how to learn--a prerequisite for all other skill development that involves identification and development of personal learning styles and strengths;
- reading, writing, and mathematical computation--the classic school subjects set in an applied context that stresses analysis, comprehension, conceptualization, synthesis, problem identification, reasoning, estimation, and problem solving;
- oral communication--inflection, body language, style;
- listening--for content, to conversations, for long-term contexts, for emotional meaning, and to follow directions;
- problem solving--recognition and definition, invention and implementation, tracking and evaluation;
- creative thinking--divergent thinking that "escapes" the limitations of logical and sequential thought patterns or problem solutions;

In addition to this list, ASTD found that employers would like employees to bring with them or develop a host of personal and organizational skills such as self-esteem, motivation and goal setting, interpersonal and teamwork skills, and leadership.[3]

ASTD's constituency is companies and organizations that engage in training activities for their employees. Therefore, this report's focus is not primarily on what the schools can or actually do. The list is, nevertheless, instructive. Like the College Board's panelists, ASTD respondents emphasize the importance of speaking, listening, reasoning, and problem solving as well as the three R's. In addition, they add a range of interpersonal and organizational skills considered critical for job success that only students at the Harvard Business School would have studied a decade ago. There is probably no better indicator of the degree to which the workplace has changed and the challenge that this reality holds for the educational system. Many (perhaps even most) employers are willing to assume responsibility for specific on-the-job training and education. However, they will rely on schools to lay the groundwork and much of what they currently desire lies well outside the boundaries of modal practice in curriculum and instruction except possibly in the best vocational or cooperative education programs where interpersonal skills, teamwork, and leadership may be systematically developed.

What is most interesting about these lists of skills needed in the workplace is their emphasis on the purpose and utility of mastering academic skills--points that are rarely if ever made clear to students sitting in classrooms. George Klemp, who has extensively studied how people succeed, concludes that the difference between exemplary performers and others has more to do with how they use what they know than with the amount of formal knowledge that they have acquired as a result of formal schooling.[4] In general, Klemp is referring to college graduates, but the observation appears to be relevant to noncollege goers as well. "Use it or lose it" has applicability to more than just unused leave time.

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[3] Anthony P. Carnevale, Leila J. Gainer, and Ann S. Meltzer. Workplace Basics: The Skills Employers Want. Alexandria, VA: American Society for Training and Development, 1988.

While employers obviously value reading, writing, and arithmetic, they are not particularly interested in the type of abstract symbol manipulation that typifies classroom instruction. Rather, they are concerned about the rational thought processes, direct people-to-people communication skills, and the ready mental access to mathematical short cuts (heuristics) that, in the best of all possible worlds, would be the standard for all employees. In short, the lists and analyses cited above seem to confirm Resnick's speculations, presented in Chapter I, about the essential mismatch between school and work. Clearly, something must be done.

Literacy. The term "literacy" is used nearly as glibly as "basic skills," and with just about as much precision. College professor E. D. Hirsch made the best seller list with a dictionary of Cultural Literacy that probably cannot be read by millions of Americans (some claim as many as 60 million) who are "functionally illiterate." However, the definition of functional literacy (and therefore the number of people who should be classified as literate or not) is currently in some dispute. A recent book, based in part on research conducted for the Department of Defense, concludes that probably only about 5 percent of a given cohort of young adults would turn out to be truly functionally illiterate, i.e., with reading levels below the fifth grade.[5] Nearly half (47 percent) of those tested read at a mid-range defined as fifth through ninth grade levels, while the remainder (48 percent) are in the high literacy category. The authors point out that the middle group contains the potential workers of most interest to business and industry--and argue that they are not functionally illiterate. Furthermore, it is not uncommon for individuals in this group to outdo high literates in mastering technical skills, given adequate background knowledge. The book suggests that training programs for out-of-school youth and unemployed adults who are mid-level literates should present basic skills (their term, not ours) materials in an applied, hands-on context. Other sectors of the education and training community, then, appear to have come to the same conclusions as the secondary schools in our study.

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[4] George O. Klemp. "The meaning of success." Liberal Education. Vol. 74, No. 3, May/June 1988, p. 37.

[5] Jerome M. Rosow and Robert Zager. Training--the Competitive Edge. San Francisco: Jossey-Bass, 1988, pp. 172-191. The research on which this volume's literacy chapter is based was conducted by Thomas G. Sticht for the Department of Defense.

The Research Base

"Problem solving," "higher order," and "critical thinking" skills are terms that, in the eighties, have surged to the head of virtually all enumerations of desired outcomes of secondary (and all other levels) of education. Educational practitioners, administrators, parents, and employers seem to use these terms interchangeably, frequently, and rather facilely to describe their belief that school must teach students more than facts and procedures. In a vague way, the layman (a category that in this context includes most of us) understands problem solving, higher order and critical thinking skills to include the ability to (1) grasp the meaning and implications of either symbolic or oral languages; (2) question, reason, and draw conclusions; (3) make decisions and judgments; and (4) assess the actual or potential results of actions taken based on our decisions.

From a research perspective, however, there is nothing to be taken for granted about such skills. The fact is, we know precious little about how individuals develop the capacity to function at full cognitive strength. Nevertheless, studies of cognitive development and how people learn in many situations and under many conditions are a growth industry in psychological and educational research. Even though it is early days for talking about a full-fledged science of learning, researchers have come to some conclusions that have interesting implications for the structure of learning in schools.

Definitions of higher order cognitive skills. According to Chipman, higher order skills are those that "involve the orchestration and practical use of the simpler skills."[6] Thus in mathematics, addition, subtraction, multiplication, and division--the basic computation skills--are low order; they are of no earthly use unless one knows when to use them. Knowing when is a higher order skill. Similarly, decoding words is a lower order skill, while reading for purpose and meaning, on the other hand, is higher order. In biology, memorizing phyla is lower order; drawing conclusions about the results of a lab is higher order. Writing (in the sense of composing, not penmanship) is by definition a higher order skill, drawing on the writer's knowledge of the subject he is writing about as well as his ability to organize the knowledge and synthesize lower order skills such as sentence structure, word usage, and punctuation to produce an intelligible representation of the author's thoughts for an audience.

Resnick offers some characteristics of higher order thinking synthesized from her own research and that of several dozen other researchers. She suggests that higher order thinking:

- is nonalgorithmic--i.e., the problem solver does not know precisely where his thinking will take him.

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[6] Susan F. Chipman. "What is Meant By 'Higher Order Cognitive Skills?'" Paper prepared for the National Assessment of Educational Progress, March 1987, p. 1.

- is complex--i.e., the thinker cannot see the whole picture from any one vantage point but rather must consider multiple perspectives.
- often yields multiple solutions which must be weighed against their costs and benefits before one is selected.
- involves nuanced judgment and interpretation.
- involves the application of multiple criteria, which sometimes conflict with one another.
- involves uncertainty since there is inevitably some aspect of a problem that is unknown.
- involves self-regulation of the thinking process. (If someone else is orchestrating the process, then it is not higher order.)
- involves imposing meaning--i.e., building a mental structure out of disordered parts.
- is effortful.[7]

In the cognitive research community, what Resnick refers to as "self-regulation" of the thinking process has an official name: metacognition. This skill is really the ultimate goal in learning to think. To the extent that we can monitor our own mental processes, we are able to determine whether or not we are on the right track to problem resolution. However, while researchers agree that sophisticated metacognition should be the goal of education, they are unsure about how to foster this all-important skill. Some favor a developmental theory, speculating that fully developed comprehension of one's own intellectual processes may not be possible until adulthood. Others suggest that development of metacognition may be less dependent on age or maturity than on how advanced one's skills and knowledge are in a particular domain. Thus, a student might be self-regulatory in one learning area (for example, how to write a research paper) but not in another (such as solving a trigonometric problem). The ability to verbalize one's thought processes (a frequent research technique in this field) is probably not sufficient evidence of metacognitive sophistication since some people may be able to describe effective learning strategies without being able to apply them in the real world, while others can do but not describe.[8]

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[7] Lauren B. Resnick. Education and Learning to Think. Washington, D.C.: National Academy Press, 1987, p. 3. Other researchers characterize the process of thinking through conceptions of the activities that they think may be going on inside a person's head, e.g. analyzing the problem, searching one's own mind for related knowledge that may be useful in problem solution, planning possible attempts at solution.

A key factor in education generally, but more specifically in learning to think, is motivation. Simply put, it is easier not to think, to let someone else do the thinking if thinking must be done at all. This is a critical part of the bargain or treaty that students negotiate with teachers, as we described it in Chapter I of this report. Because many students are unmotivated by their educational experience, particularly in high school, they are not willing to expend the effort (recall that one of Resnick's descriptors of thinking is that it is an effortful activity) that higher order, problem solving activities entail. On the other hand, they usually are willing to perform the kinds of lower level tasks--worksheets, drill and practice--that have likely been the standard of their overall educational experience anyway. Attention to motivational factors, then, is likely to be crucial in any attempt to improve the thinking and problem solving skills of adolescents.

An understanding that motivation is a critical issue in secondary education is an important but often implicit part of the rationales underlying the five curriculum integration efforts that we visited. Through an applied approach to academics, educators hope that students will discover more purpose for learning and, therefore, more incentive to engage in effortful activity. Even small increments in motivation might make significant differences in students' attitudes, achievement, and aspirations. It is certainly worth some experimentation to find out if this key human factor can be stimulated by alternative approaches to curriculum and instruction.

How cognitive skills are acquired. The more recent research on human cognition is overwhelmingly convincing on the point that learning is not linear in the sense that, as we mature, we proceed from lower to higher processes. Debate on how and when metacognition develops aside, both educational and psychological researchers agree that even the smallest children engage in higher order thinking skills as they seek to make sense of their world. In fact, the personal logic that individuals bring to bear on problems that they want to solve or situations that they want to define frequently are faulty constructions derived from "wrong" thinking--but from thinking nevertheless.[9]

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[8] Judith W. Segal, Susan F. Chipman, and Robert Glaser. Thinking and Learning Skills: Relating Instruction to Research, Volume 1. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1985, p.

[9] Researchers such as Resnick and her colleagues at the University of Pittsburgh's Learning Research and Development Center have repeatedly shown that young children's personal logic in mathematics overrides school-taught mathematical processes and procedures and is the cause of many of the errors that students make in school assignments. The problem of fallacious reasoning persists into adulthood. Researchers have identified several widespread fallacies (e.g., shortsightedness, neglect of probability, and

On the other hand, the personal mental processes that individuals develop to deal with specific, everyday situations are not necessarily always misguided. For example, there is increasing evidence that people--both children and adults--construct for themselves accurate computational strategies to solve daily problems. Furthermore, because the problems are real, important to the problem solver, and in an applied context, the degree of accuracy in problem solution is astonishingly high. One study of largely unschooled young Brazilian street vendors found that these children could mentally compute the correct answers to problems involving total cost of several items or the change that a customer should receive over 98 percent of the time when they were actually out in the streets. However, when the same problems were posed out of context as formal arithmetic word problems, accuracy dropped to 74 percent and plummeted to 37 percent for correct solution of drill and practice symbol manipulation of the very same numbers and operations.[10] We find research such as this a *very* convincing argument for the need to offer students opportunities for learning in an applied context that is as close to the real world as possible.

Evidence that people can create their own mental constructs for thinking and problem solving is by no means an argument for doing away with formal education. The position taken by most cognitive psychologists today is that thinking and knowing are intimately related. When higher order thinking skills come into play, previously acquired knowledge (and experience) is the grist for the mill. *How* to acquire knowledge is part of the repertoire of cognitive skills that people develop to a greater or lesser extent both in school and out. Teaching students to do this is a goal that is well internalized throughout our educational system. However, teaching them to know *when* to use the knowledge acquired is a far less fully articulated objective.

The conclusion that learning does not proceed in a linear fashion from lower to higher order skills has major implications for American education. For nearly two decades, curriculum and instruction in American schools have been organized around a taxonomy of educational objectives elaborated by Dr. Benjamin Bloom. Bloom envisioned learning as a set of increasingly sophisticated levels of understanding, beginning with the knowledge level and proceeding through comprehension, application, analysis, synthesis, and evaluation. Whether or not Bloom himself intended his taxonomy to be hierarchical, educators have interpreted and applied his theory in a linear fashion, presuming that children must master the knowledge level (i.e., basic skills) before they can proceed upward through the more advanced ways

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the "my-side" bias) that seriously affect our daily decisions on issues ranging from whether or not to drop out, get married, or change careers to a physician's misdiagnosis of a life-threatening condition in a patient. See Jonathan Baron and Rex V. Brown, "Why Americans Can't Think Straight," *Washington Post*, August 7, 1988, p. B8.

[10] Terezinha Nunes Carraher, David William Carraher, and Analucia Dias Schliemann. "Mathematics in the streets and in schools." *British Journal of Developmental Psychology*, 1985, 3, pp. 21-29.

of thinking. For many students (particularly those referred to as educationally disadvantaged or at risk) at all levels of schooling, the taxonomy-imposed requirement that they master basic skills before proceeding to more thoughtful material has resulted in seriously impoverished education, largely characterized by drill and practice ad infinitum.

As we indicated earlier, how people develop metacognitive skills is a matter of some debate. Although the cognitive science literature is somewhat hesitant to say that metacognition can be directly taught, some educational researchers who are closer to teachers, students, and classrooms are suggesting that we should assume it is and develop instructional strategies accordingly. They use the term "cognitive modeling" to describe a style of teaching that calls upon the teacher to very explicitly verbalize the mental steps involved in completing a task (whether simple or complex) and to directly relate the current assignment to other activities and skills. The theory is that through this type of metacognitive instruction-by-example, students will eventually internalize patterns of thought processes and begin to be able to make their own judgments about how to proceed when confronted with unfamiliar tasks.

Experts and Novices

One quite specialized area of cognitive research involves the study of differences in thought processes between experts and novices.[11] This research has focused on the mastery and use of quite advanced, complex knowledge (e.g., physics, radiology, electronics). We found it to have interesting implications for vocationally oriented learning.

In general, researchers find that expertise tends to be quite specific and is characterized by "rapid access to an organized body of conceptual and procedural knowledge." It is not necessarily related to general intelligence. Although it is certainly possible for an individual to be expert in several areas (domains), more often people become expert in one field or skill that is the substance of their life work. When a problem or situation is posed, experts can perceive large, meaningful patterns almost instantly, spend less time searching their memories for relevant information, and think only as deeply as the problem requires. In short, through repeated application, the expert's reactions and solution sets are likely to become automatic or routinized.

It is this latter point that particularly strikes us in terms of education, training, and the workplace. At least implicitly, we assume that all kinds of education and training--whether in classrooms, shops, apprenticeships, or the family kitchen--are leading toward an expert state. Yet, as one researcher has suggested, there appear to be at least two kinds of expertise: the routinized type characterized by speed, accuracy, and automaticity and the adaptive type where the expert continues to search for greater understanding through new approaches to problem solution.[12] There seems to be a greater match between the skills that today's employers are looking for and the adaptive expert. However, in general, our education and training systems may be geared to the production of routine experts. Exploration of this framing of the mismatch between education and work appears to us to be a fruitful area for research and development.

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[11] The material in this section is based on Robert Glaser's synthesis of the expert/novice research base in C. Schooler and K. W. Schaie, Cognitive Functioning and Social Structure Over the Life Course, Norwood, N.J.: Ablex Publishing Corp., 1987, pp. 81-94.

Transfer and Generalizability of Cognitive Skills

Finally, we cannot ignore what may be the thorniest issue that emerges from the cognitive research literature. Despite the widespread acceptance of the idea that schools should be doing more to teach higher order thinking and problem solving skills, there is not yet clearcut evidence (1) that such skills can be directly taught or (2) that specific skills taught in a specific context will transfer to a new context--whether that context is another classroom, a job, or the grocery store.

Educators do not seem inclined to wait for all the research evidence to be in on this score. Nor do the researchers themselves necessarily recommend a "wait and see" attitude. Outcomes and evaluations of the now quite numerous thinking skills curriculum packages (as well as the more *ad hoc* practices of classroom teachers), after all, provide continuing data for research analyses that may further our knowledge of the underlying constructs involved in thinking processes. And if it ultimately turns out that higher order skills *cannot* be directly taught but must instead emerge incrementally from many and repeated experiences, it is nevertheless unlikely that the effort to teach them will have done any harm.

In terms of transferability of skills learned in one context to a related application in a different context (e.g., from school to work), one researcher defines the likelihood of transfer thus:

> Transfer will occur *if* the new situation is recognized as being an instance of the same category as the original situation, *if* both meet the conditions of application for the trained action.[13] [emphases added]

It is precisely this set of contingencies that many of the sites involved in this study are testing (although they would be unlikely to state the proposition in these terms!). By explicitly drawing students' attention to related situations in which both academic and vocational skills can be applied, both in school and out, the educators in these settings are hoping to prepare young adults who are better learners and better doers. The results of their efforts might well be of interest to the cognitive research community.

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[12] G. Hatano and K. Inagaki. Two kinds of expertise. Paper presented at the Conference on Child Development in Japan and the United States, Stanford, CA, April 1983.

[13] Chipman (1987), p. 20.

Summary

The situation, then, seems to boil down to this:

(1) Employers and labor market analysts agree that the high growth sectors of the workplace require employees with quite sophisticated reasoning, communications, and mathematics skills.

(2) The schools (see Chapter I) are producing young adults who, at least on paper and pencil tests, show little evidence of having mastered these skills.

(3) The cognitive research community is unsure whether or not the desired higher order skills can (a) be directly taught or (b) assuming that they can, will transfer from one situation (e.g., the classroom) to another (e.g., jobs).

This scenario is clearly not a case of "If it ain't broke, ..." Something definitely needs fixing. First, it argues for a need for increased basic research in the relatively new science of cognition. In the next decade, we need to learn a great deal more about how the human mind stores, retrieves, and organizes knowledge. But we also need to encourage basic researchers to test their tentative theories in a wide variety of learning situations--including vocational shops and classrooms where instructors are attempting to develop desirable cognitive skills through an applied approach. As we noted in Chapter I, researchers such as Resnick and Gardner have themselves set the challenge: What can or should we do to recreate the schools so that there is a better fit between students, instructional approaches, and the uses of knowledge? Surely in some way and for at least some students, the answer to this question must involve a practical (vocational) side to learning.

CHAPTER IV

Conclusions and Implications

The study reported on in this volume undertook to do two things: (1) examine the current status of selected efforts to create better integration between vocational and academic education and (2) review several bodies of literature in search of evidence that curriculum integration is both desirable and, at least potentially, could be rooted in learning theory. We believe the short answer to the research questions posed by the study is that innovative efforts to achieve a closer alignment between vocational and academic curriculum and instruction represent a highly promising and logical trend that should be encouraged and supported. In this chapter, we summarize our conclusions and suggest some implications that these conclusions have for both vocational and general educational policy.

Conclusions

- Not surprisingly, the two most common activity components of efforts to integrate vocational and academic education are curriculum development and professional development.

The sites we visited approached curriculum development in different ways, ranging from a comprehensive, statewide revision of occupational and technical education curricula to decisions made by two teachers in an individual classroom. However, even with a top down, state-mandated change, the bottom line in implementation is how well teachers in classrooms accept and understand the new approach. Thus, the other universal component of attempts to alter the relationship between vocational and academic education is ample opportunity for professional development. In some cases, professional development activities are formal "in-service" programs arranged by administrators for teachers; in others, the activities (such as teacher involvement in writing curricula or visiting employers) are more organically related to the ongoing development of the overall innovation. A single site may, at one time or another, employ both these professional development strategies.

- At this point, teachers' capacities to believe in the validity of an applied approach to learning and/or think and instruct in an applied fashion vary greatly.

Resnick suggests that all students would benefit from instruction that makes much more explicit the relationship between academic learning and the uses of that learning (whether vocational or personal) outside the school. We agree with that position but see it as a very long term goal with a good deal of groundwork to be laid in the interim. The sites we visited have found that some teachers "take to" an applied approach much more readily than others. In part, this has to do with educational philosophy; many teachers firmly believe in the discipline and moral rectitude of learning for learning's sake. One is a better person for having memorized multiplication tables or the table of elements. However, resistance to applied learning is better explained by habit and tradition, with a liberal sprinkling of prejudice and elitism about the content of schooling that applies to both academic and vocational educators. Furthermore, in the typical school, academic and vocational teachers have no common ground either physically or intellectually. In short, there are a number of barriers to be brought down and they do not crumble easily.

Even assuming that academic and vocational instructors have embraced the idea of applied learning and curriculum integration and agree that they should work together toward this end, the implementation of an applied instructional approach requires new mindsets and presentational strategies in the classroom. An award-winning English teacher likely has a lot to learn about teaching applied communications, for example. Similarly, a vocational teacher with a journeyman's expertise in a trade may have little concept of how to organize and present the steps involved in a mathematical calculation that he routinely does in his head as part of a work-related task.

Another instructional issue involves the teaching of higher order thinking skills and problem solving. On paper, every one of the programs studied espouses this ideal and some teachers are able to actually operationalize instructional strategies or "model" mental processes that help students develop their ability to think. However, there is a long way to go before a dominant emphasis on thinking becomes a common--never mind universal--characteristic of classrooms. This applies to both the academic and vocational sides of an integrated curriculum and is certainly not unique to these five settings. Teaching students how to think has not been a strong suit in American education generally.

Based on our observations, then, the skill with which individual teachers handle a new approach is highly variable. Changing classroom practices is a long-term investment best measured in years rather than days or even weeks.

o A supportive environment--at both the programmatic and the individual teacher levels--is essential to the success of efforts to integrate vocational and academic education.

In Chapter II, we documented a number of types of external support that one or more of the five programs studied have received. These included special funding, enabling measures at the state level, relationships with postsecondary institutions, involvement of the private sector, etc. We also noted that the commitment and support of the leadership within a school is critical in creating an atmosphere where teachers can sustain a positive attitude toward the hard work associated with experimentation and change. We suppose that it is theoretically possible for an innovation to smother to death under the good intentions of external and internal support systems. However, from our observations at these five sites, we have to conclude that the more varied and extensive the support systems, the more impressive the outcomes.

- There is a distinct danger that expanded efforts to integrate vocational and academic education will focus on "new generation" or "high tech" vocational programs to the exclusion of more traditional programs.

Without in any way detracting from the importance and excitement attached to innovative secondary school programs with a technology focus, as a result of our work on this study we have become concerned that interest in articulating academic and vocational education will bypass traditional programs in favor of the splashier, upscale "new generation" programs. It is in many ways easier to identify the relationship between academic and vocational content with the high tech programs. Computer programming, for example, is highly algorithmic. Similarly, large numbers of the jobs associated with the health field--even the jobs that do not require a college degree--demand a strong grounding in mathematics, the sciences, and often interpersonal communications skills as well. Furthermore, since many of the high tech programs are being started from scratch, new understandings about curriculum integration can be made explicit during the staff recruitment period.

Our fear is that the more difficult job of thinking about how academic instruction can be integrated into the rather large number of traditional vocational education programs will take a back seat in any expansion of curriculum articulation initiatives. Yet it is our sense, based on our visits to the two area vocational schools described in Chapter II, that the "low tech" programs are where the most startling improvements in educational outcomes might be achieved through an applied approach to academics. To exclude these programs from innovative efforts increases the stigma associated with vocational education. In addition, it is self-defeating because thousands of students like, and are going to continue to take, cosmetology, auto shop, distributive education, and welding. At the same time they are going to continue to hate--and avoid as much as possible--the "pure" academics that they consider irrelevant because they are unable to make their own connections. We argue that these students are the greatest potential beneficiaries of an integrated program, particularly if a well-aligned curriculum leads to greater academic success, thus increasing students' post-high school options.

A cautionary note should be added here. It is certainly possible that in jumping on a bandwagon, vocational programs might adopt a minimum competency or entry-level job approach to the integration of basic and vocational skills. This would be a very constricting view of the issue and has never been what we were talking about in this study; nor is it the underlying philosophy or intended instructional goal at any site that we visited. The real objective that crosscuts these programs is a search for new strategies to help students make connections between the abstract and the applied, thus raising motivation levels and, conceivably, personal aspirations. Intentions, of course, are flimsy things, subject to multiple interpretations and enactments. Educators who undertake curriculum integration or alignment must take stock on a regular basis to assure that the intended goals have not been seriously altered by the realities of implementation.

- Evaluation needs to be strengthened as a component in the design and implementation of efforts to integrate vocational and academic education.

We were not surprised to find that evaluation plans were sketchy in several of the sites that we visited. In two cases, however, some fairly rigorous assessment procedures are either planned or already in place. As we indicated in Chapter II of this report, New York's statewide initiative is building in new tests at various points in the high school occupational education curriculum. Progress and results at the Oakland Health Academy (along with other replications of the academy model funded by the state of California) have been regularly monitored by an outside, independently funded evaluator. In the other settings, however, evaluation was not as rigorous as it should be in a vanguard movement.

We believe that it is particularly important for programs such as those at Dauphin County Technical School and Montgomery County JVS to document carefully whether or not an applied approach to academics makes a difference for students enrolled in traditional (in contrast with "high tech") vocational education programs. Another paper prepared for the National Assessment of Vocational Education suggests that state vocational educators should seriously consider using respected tests such as the NAEP instruments to validate academic outcomes for students enrolled in vocational programs. The author argues that strong performances by vocational students on recognized tests will do much to help remove the general stigma attached to vocational education. We do not disagree with this position. However, we also suggest that the outcome measures selected for evaluating such programs should be creatively and broadly framed rather than narrowly dependent on paper and pencil achievement tests. Performance tests are certainly one promising component. Exercises akin to the well-known "in-box" problems that have become a staple of executive interviews and graduate programs in business administration could be developed for assessing the real-life problem solving competence of vocational students. In addition to assessing hands-on skills, as appropriate, the exercises could deliberately include subparts that require students to use communications skills, mathematical applications, decision making, and complex problem solving.

We do not suggest that the psychometrics of such new forms of assessment will be easy--or cheap. Nor are we prepared to be more specific about what might be done in this area since it is well beyond both our area of expertise and the scope of this study. Individual schools or districts might experiment in this direction, but if a true vocational/academic curriculum integration "movement" develops, the credibility of the efforts will depend on significant and measurable outcomes. Test development specialists will need to become involved, and it is a virtual certainty that constructing, validating and norming performance-based tests of academic achievement in an applied context are likely to be expensive propositions.

For some time now, a number of schools and school districts throughout the country have, in effect, certified their vocational graduates by issuing a certificate of occupational competency that lists the vocational skills students have mastered. Students may present these certificates as part of the job application process. To the extent that potential employers know and respect the quality of a school's programs, this document can be of great assistance in matching young people with jobs. Based on what employers are saying about the basic, problem solving, and troubleshooting skills that they would prefer in their employees, we speculate that they would be delighted to receive assurances that job applicants have passed performance-based tests in these areas.

o Employers indicate that the skills they value in employees are well-matched to the curriculum designs of innovative efforts to integrate vocational and academic education.

In the early 1980s, employers indicated that they were displeased with the educational preparation of young workers. They particularly targeted "basic skills" as areas in which recent high school graduates had serious deficiencies. Generally speaking, the term basic skills was construed to mean reading and arithmetic, with perhaps a smattering of writing competence.

In the late 1980s, employers have become more sophisticated in their analyses of the skills needed for job success. A review of recent literature on the skills that employers value and the skills that employees actually must use frequently shows that while reading and arithmetic are needed, they are only part of the story. Speaking, listening, decision making, recognizing causal relationships, adaptability, and creativity have become the backbone of employer wish lists. Furthermore, it appears that reading and ciphering on the job are likely to emphasize skills that are not stressed in school, i.e., interpretation of visual displays or the ability to estimate well.

At the sites we visited, this message from employers has been heard. As they develop, revise, and realign their integrated curricula, these schools and programs are not simply focusing on basic skills in the narrowest sense of that term. Rather, each effort, in its own way, is addressing the issue of how to use the combination of academic and vocational education in expanding students' capacities for reasoning and problem solving in job-like situations.

- Mainstream educational and cognitive research currently yields little theory or evidence--either positive or negative--on the value of applied academics.

The architects of the programs we visited undertook curriculum integration because, based on their previous experience with high school students, an applied approach makes intuitive sense, particularly for those students who resist a strictly intellectual approach to learning. They did not go looking for research that would support their decision to experiment, but if they had, they would have come up empty handed.

Despite their escalating interest in the relationship between in-school learning and the ways that people learn or use their learning outside school and in the workplace, the mainstream education and psychology research communities have ignored vocational classrooms as potential research laboratories. We suspect that this is because the research community, like most highly educated people, views secondary vocational education as both inferior and inappropriate for high school students. They took no vocational courses themselves (beyond typing) and neither have their children. In addition, they tend to view vocational education as a major culprit in the de facto tracking of disadvantaged and minority students.

The result is a knowledge vacuum. We simply don't know in any broadly based or systematic way, for example, whether the strongest impact of an integrated, applied curriculum is on students' motivation and interest, thus making them more receptive to academic learning in general. Nor do we know whether an applied approach to academics should be the preferred strategy for students with certain characteristics or whether there is any correlation between an integrated and applied curriculum and future job performance. There is a great deal of fodder here for some serious research investigation.

Implications

- Vocational education should be considered part of the solution rather than part of the problem.

The innovative efforts to integrate vocational and academic education examined in this study seem to be proactive attempts to throw off the stigma that has been attached to vocational education for years. Without being either defensive or accusatory about previous relationships between academic and vocational educators, they start from the premise that we generally underestimate what vocational programs can do.

The various mainstream educational reform polemics of the 1980s have almost universally considered vocational education part of the problem. The programs described in this report--which are in line with the recommendations of the vocational community's own national report The Unfinished Agenda--turn that assumption on its head and assert that vocational education can and should be part of the solution to the problems of low academic skill levels and low aspirations among many high school graduates. Acceptance of this premise would give policymakers and educators a whole new range of possibilities for second wave school reform initiatives.

o Programs that integrate vocational and academic education may hold particular promise for improving high school outcomes for "at risk" or disaffected youth.

Some of the programs that we visited deliberately target at risk or disadvantaged high school students. Others work with all the students in a school or in particular vocational programs. The fact is, however, that whether or not students in vocational classes fit specific economic or educational definitions of disadvantagement, large numbers of them have "turned off" to purely academic education. They are in vocational programs because the activities and instruction that they find there seem to them to have more purpose and involve doing rather than merely absorbing.

The trick, then, is to develop means for making continued academic growth palatable. (As always, in this report, we are referring to academic content that is relevant to particular vocational programs, not to remediation of basic skills deficits.) That is what the programs we visited are working on--highly focused communications, mathematics, science, and (infrequently) social studies curricula that have direct and obvious applicability to students' vocational instruction, to the jobs that they hope to obtain, and to the longer term career paths that they plan to pursue.

The Oakland Health Academy and Pittsburgh's High Technology Magnet Program have demonstrated particular promise in terms of raising the postsecondary aspirations of small numbers of disadvantaged students. Programs such as these are quite distinctive models and can be easily replicated. The Perkins Act and/or states might well want to encourage "clones" of such programs.

However, to our way of thinking, the greater potential lies in supporting more broadly based efforts to integrate academic content into the more traditional vocational programs that touch a great many more at risk students. Three of our sites were working on this approach and were making real headway, but it is a rocky road. This leads directly to the third implication of our findings.

o Integrating academic and vocational education is not a "quick fix" for the ills of American education. It requires small steps, a great deal of nurturing, and a long time.

Time, of course, has implications for the funding cycles built into legislation that supports developing, demonstration, or exemplary programs. Currently, regulations for the Perkins Act allow schools or districts to receive program improvement funds in support of a particular initiative for a maximum of three years. The assumption is that at the end of that period, the innovation is no longer new or developing and therefore should be "institutionalized," that is, fully supported from other sources.

Based on what we have learned from the five sites we visited, a serious effort to restructure the relationship between academic and vocational education probably takes a minimum of 10 years. While we are not suggesting that federal legislation should set such a figure in concrete, we do see a need for some funding option that allows the federal government to signal long term support for promising initiatives. After three years, the programs we studied were barely into the implementation stage with a great many program policy decisions still down the line.

o By initiating or supporting efforts to improve the integration of vocational and academic education, the vocational community is taking a leadership role in a movement that has implications for other sectors as well.

In the current climate of concern about the "forgotten half," there are many federal and state initiatives aimed at dropout prevention/intervention and at-risk or disaffected students. Despite rhetoric in various pieces of legislation about providing "basic skills" instruction in combination with pre-employment or job training, we feel safe in asserting that the vast majority of funded programs provide fragmented pieces of an intervention rather than an integrated, applied approach involving the problem solving and higher order academic skills that employers say they want.

JTPA programs, the programs that will be funded under the new Part C of H.R. 5, and the dropout prevention programs currently supported by the Education Department's Office of Vocational and Adult Education (OVAE) all stand to benefit from documentation of successful approaches to integrating vocational and academic skills training.

o Secondary vocational educators cannot and should not attempt the task of curriculum integration alone. For a fully integrated approach to academic and vocational education to succeed, academic educators must be equal shareholders in the innovation.

We make this assertion for two reasons. First, the barrier between academic and vocational education is an artificial one, attributable to an indefensible educational tradition that values learning for learning's sake over learning for a purpose. As some thoughtful individual once observed, "If society respects the philosophers but not the plumbers, then neither the philosophy nor the pipes will hold water." Similarly, if we respect the purely academic side of education but not the applied side, then schools will not hold all the students. Both academic and vocational educators need to heighten their recognition of the complementary nature of their work.

The fact is that the discrete boxes that we have created for packaging and imparting academic knowledge to children and young people simply don't hold up in the real world. For all but a very small number of "pure" mathematicians, for example, the contents of the math box is worthwhile only insofar as it has relevance for the content of other boxes--economics, carpentry, physics, sewing, personal finances, machining, etc., etc. Academic educators have a responsibility to know and be able to demonstrate to students how the skills associated with their disciplines can be applied in other situations. Certainly one strategy for accomplishing this linkage is to forge strong interdisciplinary relationships with vocational colleagues.

A second reason for involving both academic and vocational teachers in curriculum integration efforts is based on the ways in which teachers are prepared and certified for their profession. In short, secondary school teachers are specialists--a shop teacher no less so than a biology teacher. They know one content field particularly well, along with the pedagogical strategies that work best in transferring their knowledge to students. Thus, math is best taught by a trained math teacher and carpentry by a highly experienced journeyman. By working together, they see where their areas of expertise intersect. The math teacher can adjust problems to be solved to reflect applied situations; the carpentry teacher becomes more consciously aware of the many times that computation or mathematical principles come into play in that trade. Students (and particularly reluctant students) reap the benefits, realizing that, indeed, there is a point to academic knowledge.

o Programs that are working on the integration of vocational and academic learning need assistance in developing appropriate evaluation plans and new forms of assessment.

If in fact the integration of academic and vocational education is a more successful approach to educating what the Grant Foundation calls "the forgotten half," then the early efforts to implement this approach must earn credibility by systematically validating student outcomes. As it is, not a single program that we observed (probably including New York) would have a realistic chance of attaining exemplary program status in the National Diffusion Network (NDN) for the simple reason that they have not adequately documented their positive impact on participants.

In terms of instruments for assessing program impact, most of the programs are relying on the standardized achievement or competency tests that all students in the school district take. Such tests measure pencil and paper skills in the abstract and are therefore not well aligned with revised curricula that emphasize applications of academic skills in actual problem solving situations. Packages of performance-based assessments for some vocational programs are apparently now becoming available. Use of these, in combination with standardized tests, would certainly be preferable to the paper and pencil tests alone. However, there is a definite need for psychometric research and development in the area of measuring applied academic skills. This is something that the National Center for Research in Vocational Education could support.

- States should provide incentives that encourage schools and districts to explore new approaches to integrating vocational and academic content.

School districts should not be penalized for experimenting with new approaches to the integration of academic and vocational education. That is the point of Ohio's options plan which allows a school to replace periods traditionally taught by a vocational instructor with classes taught by academically certified teachers at the maximum state vocational funding level. In some instances, then, vocational funds in Ohio are actually supporting nonvocational teachers, although that was not the case in the school we visited since the vocational instructor was officially "on duty" during periods of academic instruction. If schools stand to lose funding because of an innovative strategy, nine times out of ten the idea will die on the vine.

- Mainstream researchers in the fields of education and psychology should direct some of their attention to exploring the kinds and the quality of applied learning that can take place in vocational shops and laboratories--particularly those where curriculum alignment has been a focus.

Researchers need to make a deliberate effort to overcome their prejudices about vocational education and initiate some carefully controlled studies of what and how students learn in applied, school-based settings. Such studies must begin from a neutral position, allowing the possibility that, at least for some students, vocational classes serve as a valuable bridge between school learning and the ways in which learning gets used in the real world. In order to overcome the stigma attached to vocational education, this research should probably be a joint venture of nonvocational and vocational research entities. For example, the National Center for Research in Vocational Education (NCRVE) could work cooperatively with one or more of the labs and centers sponsored by the Education Department's Office of Educational Research and Improvement.

APPENDIX A

CASE STUDIES

Montgomery County Joint Vocational School
Clayton, Ohio A-1

Dauphin County Technical School
Harrisburg, Pennsylvania A-21

Schenley High School Teacher Center
High School Technology Magnet
Pittsburgh, Pennsylvania A-36

Oakland Technical High School - Health Academy
Oakland, California A-53

New York State Occupational Education Curriculum Revision
As Implemented at Livingston Junior High School and Albany
High School, Albany, New York; and Shaker High School,
Colonie, New York A-75

Montgomery County Joint Vocational School
Clayton, Ohio

Nancy E. Adelman

I. Overview

The Setting

Montgomery County Joint Vocational School (JVS), located in suburban Dayton, serves 27 school districts in five counties. The sending districts are suburban and rural with total enrollments that range from less than 1,000 to over 8,000 students. Only juniors and seniors are eligible to attend the JVS.[1] Most students are described as coming from farming or lower middle income families. On average, students tend to score just below the national median on standardized tests of academic achievement.

During the 1987-88 school year, the JVS served 1,866 students. Average daily attendance is just under 95 percent and the dropout rate is very low.[2] Like other area vocational centers throughout the nation, the JVS has had to recruit students aggressively in recent years. It does so through presentations to eighth graders as they outline their high school programs and to tenth graders as they are on the verge of becoming eligible for attendance at the vocational school. Because of overall declining enrollments, state funding formulas, and increased graduation requirements, home schools are at best reluctant to encourage students to attend the JVS and in some cases actively discourage JVS enrollment. Relationships are strongest with the smaller sending districts.

The physical plant of the JVS consists of three main buildings on a 200-acre site, 95 of them tillable for the agriculture program. In addition, there are two large farm buildings; an aircraft hangar and turf landing strip; a three-quarter acre stocked pond; and a golf green. After 4:00 p.m., the facility is used as an adult education center enrolling as many as 15,000 students annually.

At the secondary level, the JVS offers 49 vocational programs clustered in the broad areas of (1) business and office education, (2) agriculture, (3) health and home economics, and (4) trade and industry. Although the school's course catalog does not name prerequisites for entry into particular vocational programs, success in some courses of study (e.g., electronics, medical laboratory, and data processing) is distinctly dependent on a more rigorous academic background, particularly in math and the sciences. Because students attend the JVS full-time during their junior and senior years, the school offers a significant number of academic courses as well as vocational training. All students must take one unit of English in the junior year and one unit of social studies in the senior year in order to meet graduation requirements. In addition, courses such as algebra, geometry, Principles of Technology, biology, chemistry, and English IV are available on a schoolwide basis, as are remedial services in reading and math for students with identified problems in these areas.

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[1] The one exception is a small, experimental program for highly "at risk" sophomores.

[2] JVS administrators say that students who were absent as many as 50 days per year at the home high school have nearly perfect attendance in the vocational programs.

The Applied Academics Program

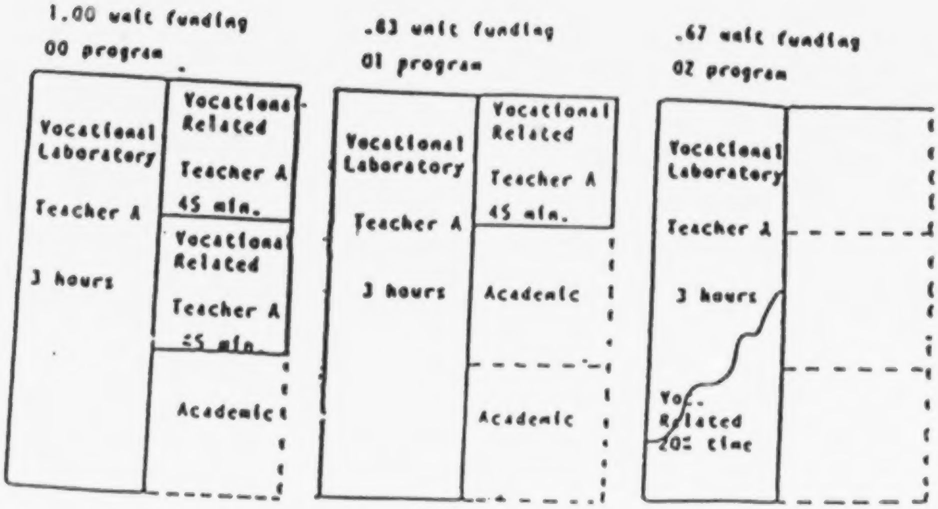
In addition to the academic offerings named above, Montgomery County JVS has, over the past four years, developed an applied academics program designed to integrate communications and mathematics skills more directly into vocational instruction. It was this program that brought us to the JVS and that will be described in some detail in the body of this case study.

The new approach has been authorized and encouraged by the Ohio Department of Education under the "Ohio plan," a set of options for the provision of vocational education. The "options" that schools, including joint vocational districts, now may adopt include various combinations of vocational and academic instruction tied to particular levels of state vocational funding. All the options require a minimum of three hours per day of vocational shop or lab. Configurations differ principally in terms of (1) whether or not vocational teachers also provide "related" instruction--i.e., specific basic or employability skills with direct application to the occupational area--and for how long, and (2) the amount of time that vocational students spend in academic classes taught by instructors certified in math, English, science, or social studies. Figure 1 outlines all the options available to Ohio schools and identifies the model that the Montgomery County JVS has elected to use for its applied academics program.

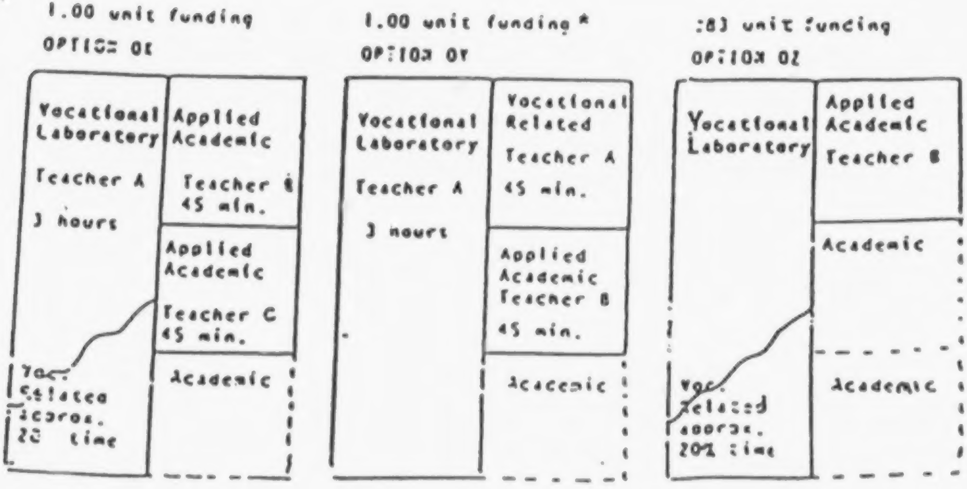
Montgomery County JVS does not require its vocational programs to participate in the academic options program. In 1987-88, 28 of the schools's 49 vocational programs participated by requiring students to take one or more communications, math, or science courses taught by academically certified instructors. Nineteen programs required applied math, 13 required applied communications, and 10 required applied science. Nine programs required both math and communications, and five required both math and science.

Figure 1

TRADITIONAL OHIO PLAN FOR VOCATIONAL UNITS



OPTIONAL PLANS INCORPORATING APPLIED BASICS



*Plan adopted by Montgomery County JVS for its academic options program

II. Development and Implementation of the Academic Options Program

Origins of the Program

At about the same time that the Ohio Department of Education was considering authorization of the academic options program, the Montgomery County Joint Vocational District undertook a review of the overall approach to education at the JVS. The reasons for the review included declining enrollment and the fact that students who were enrolling were demonstrably lower achievers than had been the case in previous years. The superintendent of the joint vocational district and director of Pupil Personnel Services for the JVS spearheaded the re-examination of the program. The committee included three counselors, three principals, and three superintendents of sending districts, in addition to staff and faculty of the JVS.

The committee seriously considered two options: (1) moving to a half-day rather than a full-day vocational program and (2) increasing the number of academic classes taught by academically certified teachers. Ultimately, the committee decided to experiment with applied math and communications courses and to institute more rigorous course recommendations or requirements in some specific programs. For example, business and office education students would be able to take algebra I or II and English IV during their two years at the vocational school, although they would not be required to do so. Architectural drafting students could enroll in English IV and either algebra or Principles of Technology. Industrial drafting, electronics, and electrical trades programs would have upgraded math and/or science requirements.

At the time these decisions were being made four years ago, the committee canvassed the home school districts to determine whether the new plans would be considered an infringement on their territory. The answer then was "no." However, as their enrollments continue to decline, some home school personnel would now like to reconsider the half-day option.

Philosophy of the Program

We were unable to obtain any document that specifically explains the philosophical underpinning for the JVS' decision to experiment with a program that better integrates academic and vocational instruction. However, in conversation, educators at the JVS identified three basic rationales or beliefs that clearly guide their thinking about how to improve the school's vocational programs. The first is that general academics are needed in many if not all vocational programs. This position appears to be based both on personal experience and on statements from employers (both local and national) about the skills that are desirable in entry-level employees. The second underlying belief is that students should keep their postsecondary options open. While the JVS sends relatively few of its students directly on to further education or training, administrators and staff accept the maxim that in the current and future labor market, workers must be prepared to train and retrain throughout their working lives.

A third tenet of the applied academics program philosophy is that a vocational school serving juniors and seniors in high school cannot realistically hope to remediate the all-too-frequent reading skill deficits of students who have experienced years of school failure. What it can do is emphasize other aspects of general language competence (e.g., speaking, listening, observing, certain types of writing) and occupationally specific reading tasks. For example, in the law enforcement program, students need to learn how to talk with all kinds of people under all kinds of conditions and to write reports that very accurately describe what happened. These are both conceived as occupationally related "communications" skills rather than English or reading per se.

Critical People

Individuals both inside and outside the Montgomery County JVS believe that the program's success is largely attributable to the school's academic coordinator, who has supervisory responsibility for the 37 academically certified instructors. She is a highly experienced teacher and supervisor with an English literature background who at mid-career retrained as a reading specialist. She has been at the JVS for 13 years and has, in her own words, "become a drum beater for the value of vocational education." Her commitment is based not so much on the value of vocational training to students' post-high school options as on an area vocational school's potential to provide students who have never been the "stars" with a measure of success and the opportunity to learn some leadership skills.

The academic coordinator supervises all teachers in the school holding academic certification, including the eight math teachers and three communications teachers who directly participate in the options program. It has also been her responsibility to find teachers who understand and are sympathetic to the program's philosophy and to create optimum matches between vocational and academic instructors. In the long run, she believes, this may be the most important part of her job.

School administrators have been extremely supportive of the academic options program. The academic coordinator reports that she has received particularly critical backing from the JVS superintendent, the building principals, and the director of Pupil Personnel Services. We had a sense that employer input was not a great factor in the planning, development, and implementation of the academic options program. There is a craft committee for each vocational area as well as an Advisory Committee for the school as a whole.

Planning and Development Activities

In the past, the Montgomery County JVS had attempted to implement a number of strategies to promote basic skills education through vocational programs. None of these had been notably successful. For example, through intensive staff development efforts, the school had tried to train vocational instructors to teach reading, writing, and math. In the long run, there was little transfer of this training to the classrooms and no identifiable student gains in performance or achievement.

Another strategy employed was provision of a math coordinator to serve as a consultant and curriculum development resource to the vocational classes. After three years, this approach was terminated, largely because the coordinator was unable to break down the resentment of many vocational instructors toward what they viewed as interference in their classes.

A third approach that had been tried and rejected was a math lab where designated students were sent by their vocational instructors to receive individualized instruction. This pull-out model caused students to miss critical vocational instruction and resulted in only minimal gains in student achievement.

Armed with what they knew to be unworkable, the JVS planning team therefore sought an approach that would (1) require academic and vocational teachers to work together in close cooperation, and (2) result in the development or implementation of curricula that made very clear to students the relationship between academic skills and their chosen vocational programs. The plan they developed placed academic and vocational teachers in the same classroom at the same time during periods of academic instruction, thus greatly increasing the probability that the two camps would establish a working relationship. At the same time, the academic teachers were strongly encouraged to observe in both vocational classrooms and actual worksites in order to gain an understanding of vocational applications relevant to their areas of expertise.

Staff development has played an important role in program implementation and continues to do so. The academic coordinator has control over the school's Chapter II block grant funds, which amount to about $10-12,000 annually. Each year, she forms a teacher committee to conduct a needs assessment for staff development activities. In recent years, staff development areas addressed have included (1) training academic teachers in the arts of holistic evaluation used with the writing program; (2) approaches to peer observation, designed to help break down the barriers between academic and vocational teachers; and (3) writing for vocational instructors. This year, staff development activities focused on a program called TESA--Teacher Expectations/Student Achievement--which emphasizes the affective side of teaching. The program is designed to make teachers more conscious of classroom approaches such as giving all students an opportunity to respond to questions, distributing praise equitably, and asking questions that call on higher order reasoning skills as well as students' knowledge.

Implementation Schedule

Once the planning team had agreed on the outline of the approach that they would take, they undertook the process of selling their idea to the vocational programs. Implementation began slowly. Three programs participated during the pilot year: electronics, welding, and auto body. These programs were selected as generally representative of high, average, and low achieving students in the school, on the basis of math test scores.

During the first year of the program, the auto body teachers frequently observed, "We don't use math; there is no point in having our program participate in the options." However, as the year went on, ideas started to generate "like popcorn" in the auto body shop. Results were encouraging, both in terms of student outcomes and the breaking down of barriers between vocational and academic departments. The welding program--representing students at about the mid-range of academic achievement among JVS enrollees, chose to introduce a course in applied mathematics. In fact, the volume of mathematical applications ultimately detailed by the welding instructors and math teachers was an eye opener for the member schools' counseling staffs.

Over a four-year period, over half of the school's vocational programs have opted to participate in the applied academics program for one or more periods per day. No programs have been forced to sign on, and in fact, none of the Business and Office Education programs participates. Table 1 shows program-by-program participation in the three academic areas during the past school year.

Funding/Resources

Funding has not been a particular issue in planning and implementing the academic options innovation. The Montgomery County JVS is described as being in "a fortunate economic position." Its relatively high level of funding has enabled the school to add the applied communications and math teachers to participating programs as additional (rather than replacement) instructors in individual classrooms. The applied academics program is totally locally funded in terms of allowing two teachers to be in a single classroom at the same time. The JVS superintendent pointed out that, in reality, this is not nearly as expensive as retaining a Latin teacher for a class of six students, a not uncommon phenomenon in comprehensive high schools.

Table 1

Programs Participating in the Academic Options Program 1987-88

MATH

- Agri/Diesel/Industrial Mech.
- Auto Body
- Carpentry
- Child Care
- Diesel Equip. and Mechanics
- Drafting-Architectural
- Drafting-Industrial
- Electrical Trades
- Electronics
- Farm Management
- Heating & Air Conditioning
- Law Enforcement
- Light Duty Gas/Diesel Mechanics
- Machine Trades
- Masonry
- Medical Assistant
- Plumbing
- Restaurant Service
- Welding

COMMUNICATIONS

- Agri/Diesel/Industrial Mech.
- Auto Body
- Child Care
- Dental Assistant
- Diesel Equipment and Mechanics
- Farm Management
- Floral Design & Greenhouse Mgt.
- Law Enforcement
- Light Duty Gas/Diesel Mechanics
- Masonry
- Nursing Assistant
- Restaurant Service
- Sportsturf

SCIENCE

Principles of Technology (physics):
- Auto Mechanics
- Auto Machine Shop
- Diesel Mechanics
- Heating & Air Conditioning
- Electrical Trades
- Electronics
- Drafting-Industrial

Chemistry:
- Medical Laboratory

Biology:
- Environmental Science
- Animal Production & Care

III. Specific Strategies in the Integration of Academic and Vocational Content

Curriculum

No formal curriculum development activities have accompanied implementation of the academic options program at the Montgomery County JVS. Rather, curriculum development has occurred on a classroom-by-classroom basis. It is an ongoing process, with the teachers constantly seeking or devising new materials, problems, and exercises that will make the links between their vocational training and academic skills explicit.

In the applied academics classrooms where we observed, none of the instructors relied on textbooks as a basic source for the material they were presenting. Rather, they were using teacher-made overhead projections, worksheets, group discussion exercises, or pieces of published material drawn from a wide variety of sources. For instance, in the horticulture communications class, we observed a lesson concerning personal money management. (Although this was not directly related to the horticulture curriculum, the vocational teacher said that about half of the content over the course of the year is drawn directly from that source.) The sample personal budget under discussion was drawn from one book, while an article that students were to read came from a magazine. Both the horticulture teacher and the communications teacher are constantly on the alert for articles and other relevant materials for use in the communications segment of their program.

As part of the academic options program, the JVS also offers several sections of a well-regarded new applied physics course called Principles of Technology (PT). Developed by the Center for Occupational Research and Development in Texas, PT is an intellectually rigorous program that this school finds appropriate for students in some but by no means all vocational programs. At the current time, PT is required or recommended in programs such as electronics, electrical trades, industrial drafting and design, heating and air conditioning, auto mechanics, automotive machine shop, and welding.

PT is theoretically a two-year course of study that includes 14 units of instruction, each devoted to one physical principle as it is applied in the four energy systems--mechanical, fluid, thermal, and electrical.[3] Each unit contains plans for 26 lessons, including lecture and discussion material, applications labs, and review. A number of video presentations are included as part of the curriculum package, presumably replacing the long-familiar filmstrip.

At the JVS, we observed in a PT class for seniors enrolled in the school's electronics program. About 15 students were present, including one girl. The instructor is certified in science, math, and guidance. This is his second year with the PT curriculum. The lesson on this particular day concerned capacitants as a measure of storing electricity. It was clear that in May of their senior year, these students had absorbed a great deal of knowledge about physical principles and also had the math background to catch the teacher out if he made an error in either a formula or an application when writing on the blackboard.

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[3] Schools that have adopted PT are using the curriculum in various ways. Even where the program is presented as a two-year science curriculum for juniors and seniors, it is apparently rare for a class to complete all 14 units. High school teachers tend to take students as far as they reasonably can with any assurance that the material is being thoroughly understood. In some locations where high schools and postsecondary institutions have closely articulated programs, PT is begun in the senior year of secondary school and completed at a community college or vocational-technical school.

Throughout the class, the instructor consciously tried to help the students make connections between their vocational program labs and the material being covered. In fact, the students articulated many analogies themselves. The teacher, however, was at somewhat of a disadvantage because he had never seen the full two-year syllabus for the vocational electronics program. At one point during a discussion of flywheels and coils, one student remarked to his peers, " I suggest that we all reread our junior lab books," referring to the logs they were required to keep in their vocational program last year. The PT teacher reminded the boy that he had promised to bring in his lab book so that the science instructor could become familiar with what the students had already covered. This seemed to us to be an obvious instance where vocational and academic teachers should have better channels of communication. We were unable to determine why these had not been established.

The academic or basic skills instruction that students receive at the JVS is by no means restricted to the applied classes that are part of the options program. Through English, communications, or related vocational classes, all students in the school participate in a developmental writing program. A writing folder is kept on all students for the two years that they are in attendance. The goal of the writing program is to have a student increase one full point per year on a holistic writing evaluation scale that ranges from a low of 1 to a high of 7.[4] Students are assigned 18 writing activities each semester, including four essays. The writing process includes pre-writing activities (research, planning, outlining, etc.), first draft, rewriting, final draft, and "publishing." On the average, students improve about three-fourths of a point in the junior year and a full point in the senior year.

There are four remedial reading teachers on the JVS campus. Students with severe reading problems receive content area-based remedial instruction in groups of 12-15 during their regularly assigned social studies or English periods. Gains are measured through a system of pre- and post-testing. Results are mixed. A few students show great gains; most do not. The school has attempted to train vocational teachers to help their students with reading through summer workshops. In general, this strategy has not been successful. The teaching of reading requires special and sustained training that a workshop cannot provide. The academic coordinator reports that it is more effective for vocational instructors to provide the reading teachers with occupationally specific terminology to be incorporated into planned remedial activities.

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[4] The scale used is similar to scoring systems used by states that require a writing competency test for high school graduation. The JVS has adapted the scale to include much finer distinctions at the bottom end where most of its students start out.

Instructors

The Montgomery County JVS employs from one to six vocational instructors for each occupational program and 37 academically certified teachers. In most instances, vocational teachers work with one group of students each day in a three-hour lab and for one or two "related" periods. In the first four years of the program, the applied academics teachers have generally been required to teach from four to six classes per day. Next year, the intention is to limit the actual teaching load to four periods, thus allowing officially scheduled time for the academic teachers to observe in the vocational shops and labs.

At least initially, vocational instructors and academically trained teachers bring very different perspectives to a team teaching situation. For example, some vocational teachers will freely admit that, while they can personally use mathematical skills effectively in their trade or profession, they do not necessarily know how to impart this knowledge to their students. Furthermore, when there is so much to teach students about job-related tools, procedures, processes, and behaviors, it is all too easy to give short shrift to the academically related skills that may not be on one's priority list of necessary vocational competencies.

On the other hand, the academic teachers have been trained in a "purer," more abstract approach to their disciplines. While every mathematics teacher can name fields or situations where algorithms and formulae are actually applied, their instructional approach is typically to present an ordered body of knowledge to be learned for its own sake, not because of its long-range utility. The vocational teachers at the JVS talk about having to get math teachers to "think the shop way." This phrase is not clearly defined in their own minds but appears to refer to skills in estimating and problem solving on one's feet that allow an expert to make cost-effective judgments about materials needed, the time a job will take, and glitches that must be overcome. It is an interesting concept that seems to be directly related to a body of cognitive research on novices and experts that we are relatively certain no one in this vocational school has ever heard of.

When applied and vocational teachers are committed to making the integrated approach work _and_ when the chemistry is right between them, extraordinary things can happen. In the next section of this case study, a highly successful communications class for auto body shop students is described. The end of the year role-playing exercise that we observed worked because the male auto body teacher and the female communications instructor put a great deal of effort into establishing a viable instructional relationship. Students in this vocational program had to be convinced that anything remotely academic could be of use to them; they were "hand" men, not "head" men, and to some extent, the vocational instructor held similar beliefs at the outset. Several months later he felt very differently.

In the course of a school year of learning and accommodating, the auto body teacher and the communications teacher have walked a group of low-achieving students through lessons that stressed talking with the public, handling anger and frustration, defusing confrontational situations, and setting personal goals, among other topics. Working in the same classroom with a group of reluctant and sometimes overtly hostile youth, they have naturally fallen into "Mom and Dad" roles with the students. When a boy acts up in communications class or falls behind on assignments, the communications teacher first reasons and cajoles. If this tactic fails, the vocational instructor steps in with a harder disciplinary line. As in any healthy family, the students ultimately realize that both adults care and are interested in seeing them succeed.

Establishing a professional relationship was a gradual process for this pair of teachers. In the instructional planning approach that worked for them, the academic teacher developed lesson outlines that were reviewed by the vocational teachers.[5] According to both instructors, the key to a successful working relationship is flexibility, an ability to "wing it" when needed, a good sense of humor, an ability to see students as individuals, and a basic humanistic impulse. Competence in one's area of instructional expertise is a necessary but not sufficient given in this equation. In their opinion, a great English teacher may not be good at teaching the communications skills that their vocational students need.

Some vocational programs and individual teachers have been resistant to the innovation. Home economics, for example, has been supremely uninterested in participating in the academic options program for reasons that are unclear. Some trade and industry teachers who have been teaching shop math in their related periods of instruction are unwilling to acknowledge that they may not know the subject well enough to teach it adequately. On the other hand, some programs may not need to be assigned an academic teacher through the options program. For example, at this school, one of the two teachers in the animal science program is certified to teach biology as well as vocational agriculture. While participation in the options program has guaranteed that a full period of the animal science curriculum is set aside for biology instruction each day, there has been no need to introduce a new teacher into the program.

The vocational instructor in the interior design and fashion program has been a reluctant participant in the applied academics program. While she believes that communications and mathematics skills are important for her students, she feels that these areas were adequately covered under the old system of related classes. The academically certified teachers, in her opinion, will not necessarily have a good handle on appropriate examples to use with students in particular occupational programs.

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[5] Although we observed in only one class, the communications teacher works with two auto body instructors.

In response to this reservation, the math teacher assigned to the interior design program (as well as to the child care and restaurant/hospitality programs) believes that the academic options program can work if the vocational and academic teachers have adequate up-front time for planning. One strategy that he used to orient himself to the relevant occupational areas was "field trips" to the types of businesses and agencies where students would be likely to obtain jobs. With the child care program students, for example, he works on consumer math, calculations related to good nutrition and meal preparation for young children, and the development of number sense in preschoolers. Students in the restaurant program do a great deal of problem solving involving conversion of measurements in recipes and purchase of food in bulk.

Classroom Practices

Ultimately, the best way to obtain a sense of what the Montgomery County JVS is attempting to achieve is to sit in classrooms. I observed for the full period in a carpentry math class taught by a very attractive young woman who teaches applied math in five different vocational programs. This latter point is not insignificant. In order to do an effective job of planning and presenting her classes, she must be familiar with the appropriate applications of her subject in a large number of occupational areas. That is a tall order.

The carpentry class is reviewing slope and pitch. Formulas are involved and the students continue to confuse them. For example, pitch is rise over span. Slope is rise over run, which is half a span. In order to reinforce the concept of a ratio, the teacher makes reference to an article on compression ratios in a recent Car and Driver magazine. This is obviously something the students can relate to and she gets her point across. The math teacher explains that you need ratios for tasks such as putting in downspouts and constructing decks, jobs that she knows some students will hold during the upcoming summer. Most of the students are taking notes as she suggested that they should.

The teacher poses a problem: If it takes a carpenter and his helper one hour to hang 20 feet of gutter, how long will it take them to hang 150 feet? The class works this out together. She points out that this is something they will commonly have to do when a customer asks for an estimate. Next, the teacher presents the class with a "real" problem involving her own backyard where she is engaged in constructing some terracing. For extra credit, she challenges the students to figure out how to convert cubic feet into the number of pounds of topsoil that she will need to buy. The students are very attentive as she lays out the problem. At first, they make many suggestions that do not involve mathematics: "Buy two truckloads of dirt and return the extra!" Some, however, begin to seriously search for a mathematical solution.

A communications class for students in the auto body program was equally impressive. In general, the auto body program does not attract high achievers. This is the first year that the program has been involved with the communications option and at the beginning of the year, the instructors had some reservations about its value for "their boys." The students themselves were described to me as being hostile to the communications instructor and the whole concept of the class at the outset. By May when we visited, they had clearly been won over.

The communications teacher had planned a role-playing situation. All of the students participated, either taking a character part or acting as an observer/reporter at the end of the scenario. The situation posed was this:

> On a typical day in an auto body shop, the owner has gone on a fishing trip and left his employee, John Smith, in charge. Other employees include Larry, who works hard but is impatient; Curly, who does good work slowly and whose wife is nine months pregnant; Moe, who is a co-op student from the JVS; and Dan, the office manager and brother of the boss. There are two cars in the shop to be worked on. One belongs to Mrs. Spencer and the body work is finished, the painting half finished. The second belongs to Mr. Wellington, who is using the shop's "loaner" car; his own car needs parts that the shop does not have on hand.

Using some prompts from the communications teacher, the students spent an entire class period enjoyably playing out this scene. Despite the presence of two observers, they were unselfconscious, motivated, and creative. The auto body shop instructor thoroughly enjoyed himself in the role of the absent Otto of Otto's Body Shop, calling on the telephone periodically to check on the work flow. As he occasionally glanced at the visitors, his face reflected the pride that he felt in his "boys" who, he later told us, could never have expressed themselves as easily a few months before.

When the role playing ended, the communications instructor called on the student observers for their comments regarding the behaviors of the actors. One particularly astute student drew on both his business sense and his powers of observation to point out that the "acting manager" needed to be more systematic in running the shop and that the front office should be better organized, particularly in terms of telephone coverage and the writing down of messages.

Evaluation of Effectiveness

While there are not a lot of hard data to prove the point, JVS administrators and the academic coordinator believe that the integrated approach to academic and vocational education has made a real difference in students' levels of competence. As a result of participation in the applied academics associated with the options program, achievement test scores for students in the auto body program moved from far below average to close to the median. Scores for welding students moved from the mid-range to the top quartile. The academic coordinator describes these results as "a very heartening outcome." As noted earlier, the schoolwide writing initiative has resulted in average gains of three-fourths of a scaled point per year for juniors and a full point for seniors.

In terms of teacher evaluation, the academic coordinator uses a clinical model of teacher evaluation with her 37 academic teachers. This involves a preobservation conference, a minimum of 30 minutes of observation, and a postobservation conference. At the current time, vocational coordinators do not formally evaluate the applied academics teachers, although the academic coordinator makes it a point to talk with the vocational coordinators about her evaluations. She believes that the optimum evaluation strategy would be a four-way conference involving both coordinators and both instructors. However, the academic teachers in particular are apprehensive about this.

The academic program is evaluated by the North Central Association. Vocational programs are evaluated periodically by a state-based team as part of Ohio's Program Review, Improvement, Development, and Expansion (PRIDE) effort.

The director of Pupil Personnel Services is responsible for follow-up on recent JVS graduates. He estimates that on the average, from eight to 15 percent of JVS program completers go on directly for postsecondary education on a full-time basis. In many programs, the combined percentages of students in training-related placements or pursuing additional education are quite high one year out of school, as Table 2 indicates.

Ohio is considering a new measure that would require schools to show at least a 60 percent training-related placement rate in order to qualify for full vocational funding. The figures in Table 2 show that while many JVS programs would have no trouble meeting this requirement, others would be highly at risk. In some instances, the requirement would surely provide incentive for better post-high school tracking of program graduates.

Table 2

Follow-up Data for 1987 JVS Graduates[a]

Program	Total number of students	Percent training-related or postsecondary placement	Percent status unknown
Drafting/CAD	4	100	0
Machine Trades	25	92	4
Fashion/Int. Des.	11	90	9
Community & Home[a]	7	85	14
Agri. Diesel Mech.	11	81	0
Farm Mgmt	11	81	9
Heating/Air Cond.	25	78	5
Diver. Coop.	17	76	17
Elec. Trades	20	75	5
Light Duty Mech.	4	75	0
Nursing Asst.	4	75	0
Rest./Hospitality	16	75	0
Accounting	15	73	6
Agencies Secretary	15	73	0
Medical Service	15	73	13
Plumbing	15	73	0
Masonry	7	71	0
Auto body	27	70	15
Recept./Clerical	17	69	11
Archit. Drafting	16	68	12
Auto Mach. Shop	9	66	11
Exec. Secretary	18	66	16
Graphic Comm. Arts	24	66	8
Data Processing	34	65	24
Word Processing	23	65	13
Carpentry	17	64	11
Cosmetology	44	64	11
Floriculture	14	64	0
Aircraft Mech.	17	58	11
Diesel Mech.	17	58	5
Welding	19	57	0
Auto Mech.	29	55	28
Legal Secretary	16	55	43
Environ. Sci.	17	53	5
Finance & Banking	15	53	33

Table 2 (continued)

Program	Total number of students	Percent training-related or postsecondary placement	Percent status unknown
Graphic Photog.	15	53	33
Medical Sec.	15	52	13
Avionics	10	50	10
Medical Lab.	6	50	0
Medical Services	16	49	18
Elec. Communic.	15	46	33
Law Enforcement	19	46	10
Auto Service[b]	14	43	21
Elec. Industrial	21	37	9
Graphic Printing	25	36	24
Animal Prod./Care	10	30	30
Child Care	13	30	23
Occup. Work Exp.	4	24	75
Dental Asst.	18	22	11
Dental Lab.	5	20	0

[a] Table reports only two of seven response categories. Therefore, row percents do not equal 100.

[b] These programs are for I.E.P. students only.

IV. Issues

The Montgomery Country JVS approach to implementing Ohio's academic options alternative for vocational programs shows a great deal of promise. It differs from other programs that we visited and even from other option plan approaches in its own state for two principal reasons: (1) both academic and vocational teachers are required to remain in the classroom during the academic skills classes, and (2) the content of communications classes focuses on the language arts skills of observing, listening, understanding oral communications, and practical writing rather than on the staples of high school English classes such as grammar, formal writing, and reading literature. While the option program math classes we observed were particularly effective examples of the potential of applied academics for vocational students, they were also less unique in the sense that occupationally related math competencies are generally better identified and more frequently taught than occupation-specific communications.

Several issues arise from this site visit, both in terms of the future of the academic options program at this particular school and its potential to serve as a model that might be replicated in other settings. In this section, we outline those issues that appear to be critical factors in an effort to better integrate vocational and academic education for high school students.

Teachers

Ultimately, the success or failure of the experiment at the Montgomery County JVS will rest almost exclusively on the willingness and ability of teachers to change mindsets and classroom behaviors that are thoroughly entrenched. Like all of us, experienced teachers develop routines, habits, and biases associated with their work that are difficult to uproot. The first precondition for participation in the academic options program is really a readiness to entertain the idea that there may be a different (and possibly better) way of presenting academic skills instruction to vocational students.

Because many teachers today agree that the students entering their classes have serious basic skills deficiencies that are frustrating to both teacher and pupil, it is perhaps an optimum time for receptivity to instructional innovation. However, while interest and openness are necessary conditions for change, they are not sufficient for success. The structure of the options program at the JVS requires participating academic and vocational teachers essentially to team teach. For many teachers, this is not "natural." Teaching is something that occurs privately between you (the expert) and a group of novices. It is not an act that is typically observed by peers or outsiders and is only rarely observed or critiqued by supervisors. Therefore, the prospect of entering into a situation where classroom dynamics and the quality of instruction will regularly be under the scrutiny (however uncritical) of a peer represents a major departure from the norm.

Although apprehension about team teaching applies to both academic and vocational instructors, there is an unspoken implication that because of long-standing status issues, the teaming approach is more threatening to vocational teachers. The academic coordinator at the JVS believes that half the battle in implementing the school's options program is won or lost on the basis of the matches made between academic and vocational teachers. She spends a great deal of personal time on this issue, talking with both teachers when conflicts arise, sizing up personalities and instructional styles, moving the academic instructors around, recruiting academically certified teachers who seem to have the right combination of attitudes and skills to make the approach work. It is a time-consuming and highly imprecise science that calls for a great deal of tact and patience.

The JVS has used the implementation of the options program as an opportunity to introduce other staff development efforts designed to expand or change the range of teacher behaviors. The goals tackled by professional development workshops have been significant ones, e.g.:

- training all instructors to teach writing
- training teachers to be self-conscious about their expectations for particular types of students
- training teachers to ask questions that require more than simple recall of facts

None of these efforts can be expected to have spectacular short-term payoffs. All require changes in classroom approaches that take time to master and become routine, which leads us directly to the next major issue.

Time

The Montgomery County JVS has been working on implementing the academic options program for four years. No one believes that the process of implementation is complete. In fact, no one even talks about an expected timeframe for "completion" of the change. The school is actually working with a fluid and evolving concept rather than with a "project" that at some point might be considered finalized. Even if all 49 vocational programs in the schools had already embraced the idea of the options program, the identification of program-specific academic skills, experimentation with new motivational tools, and creation of new materials and curricula could be expected to go on for many years.

The issue of time seems particularly relevant. Research studies on the capacity of federal programs to produce change at the local level suggest that fixed-term grants or funding cycles tend to ignore the point at which a particular district or school starts in the change process. Capacities to innovate vary widely. It may take one setting three years to "unfreeze" the status quo before the planned change can be implemented.[6] This raises questions about funding and evaluation cycles that should be carefully considered before any policy recommendation is framed.

Participation

The Montgomery County JVS has not required all vocational programs to participate in the academic options program. This is in contrast to the approach taken at Pennsylvania's Dauphin County vocational school[7] and to other joint vocational districts in Ohio, notably the Great Oaks JVS in Cincinnati, which has received considerable national press on its options program.

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[6] See, for example, Paul Berman and Milbrey W. McLaughlin, Federal Programs Supporting Educational Change, Vol. IV, the Findings in Review, Santa Monica, CA: The Rand Corp., April 1975, p. xi. Also, Sheila Rosenblum and Karen Seashore Louis, Stability and Change, NY: Plenum Press, 1981, pp. 273-274.

[7] See the case study included in this volume.

The decision to make the options program "optional" is a local policy decision rooted in research about educational change. Administrators at the Montgomery County JVS believe that it is fruitless and probably self-defeating to force teachers to accept innovations before they are ready. Most of the programs now participating were, at a minimum, skeptical at the outset. However, there is a qualitative difference between healthy skepticism and outright hostility or negativism. The academic coordinator has come to accept that some programs at this school, such as business and office education, may never participate, despite the fact that this program is among the heaviest users of the communications option on a statewide basis.

Curriculum

Development of the options program at Montgomery County JVS has proceeded without an overall curriculum design. Individual teams of teachers have developed or found appropriate materials as they feel their way along in the new relationship. For the most part, the integrated mathematics and communications skills or competencies that are emerging on a program-by-program basis are drawn from the established vocational curriculum and from the observations of academic teachers as they become increasingly familiar with the requirements of the various program-related jobs that students may ultimately enter. In many cases, the academic teachers have been able to find some guidelines in the syllabi used by vocational teachers in their "related" periods of instruction.

The current academic coordinator at the Montgomery County JVS believes that when she retires in the not too distant future, the school should seriously think about replacing her with a new academic coordinator and a curriculum specialist qualified to work with both academic and vocational teachers. While she does not advocate development of a standardized curriculum for the integration of academics into the vocational program, she suggests that the efforts of individual teaching teams would benefit from some degree of systematic structure. The relationship between curriculum and instruction appears to be an important issue for consideration as schools undertake activities to integrate academic and vocational content.

Dauphin County Technical School
Harrisburg, Pennsylvania

Nancy E. Adelman

I. Overview

The Setting

The Dauphin County Technical School (DC Tech) is a comprehensive area vocational school serving six suburban and rural school districts near Harrisburg, Pennsylvania. The term "comprehensive" indicates that the school is not a shared-time facility; rather, students spend their entire day at the technical school, which offers all the academic subjects required for graduation as well as occupational training. While there are 80 area vocational centers in the state, only nine are organized as comprehensive schools.

Opened in 1970-71, DC Tech was designed to house over 1,000 students. Current enrollment is about 800, a figure that is larger than the home high school enrollments in five of the six participating districts. While there are relatively few minority students at the school (less than 10 percent), the student body represents a wide range of socioeconomic characteristics, from "poor mountain folk" to affluent suburbanites. Average daily attendance hovers at about 89 percent; administrators and faculty have set a goal of 95 percent as acceptable.

The technical school serves students in grades 10 to 12.[1] Most vocational classes are not segregated by grade. However, because of math and science prerequisites for some upper level courses, certain "high tech" programs organize their curricula around a grade level progression. For most programs, instruction is on a "week on/week off" schedule. This means that students spend a week exclusively in vocational classes and the succeeding week in academic classes. During the "week on" academics, they attend two periods per day of English, math, and the other academic requirements associated with their specific programs. The double periods are not, however, scheduled back-to-back. Again, programs in the technical careers cluster are the exception to this scheduling rule, as is distributive education.

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[1] The one exception is an experimental exploratory vocational program for at-risk ninth graders. Last year, DCTS challenged its six sending districts to identify the freshmen most likely to drop out and pledged to develop a program designed to keep them in school. Next year, this program will double in size.

DC Tech has received national publicity in recent months because of its innovative approach to restructuring the relationship between academic and vocational offerings. The school has eliminated the traditional departmental structure found in most high schools and has organized all faculty into four occupational clusters: technical careers, service careers, construction careers, and communications and transportation careers. A manufacturing cluster was dropped and the technical cluster added in 1987-88 in response to changes in the local labor market. Table 1 details the vocational programs offered in each of the four clusters currently available at DC Tech.

Table 1

Occupational Clusters and Vocational Programs
Dauphin County Technical School

Communications and Transportation Cluster

- Auto Body Repair
- Automotive Mechanics
- Commercial Art
- Graphic Arts
- Machine Shop

Construction Cluster

- Air Conditioning & Refrigeration
- Building Construction & Maintenance
- Carpentry
- Electrical Construction & Maintenance
- Masonry
- Sheet Metal & Welding

Service Cluster

- Cosmetology
- Health Assistant
- Marketing & Distributive Education
- Ornamental Horticulture
- Food Production, Management & Service

Technical Cluster

- Chemical Technology
- Electronic Technology
- Data Processing
- Drafting & Design Technology

Academic teachers (including English, math, social studies, science, and health/physical education instructors) are assigned to a specific cluster and work only with students in that group of programs, frequently instructing the same students for multiple years. The objective of this reorganization is to provide students with "an articulated educational program across academic and vocational disciplines."

II. Development and Implementation of the Program

Origins of the Program

The director and assistant director of DC Tech conceived the idea of restructuring the school's approach to curriculum and instruction while attending graduate classes at Temple University. The concept of clustering that they adopted is derived from the fairly common middle school practice of organizing instruction around teaching teams or "pods." Working under the mentorship of Dr. Joseph English (currently director of the Maryland Vocational Curriculum Center), the two DC Tech administrators developed a plan for applying this organizational structure to a three-year comprehensive vocational school.

It should be noted that there have been considerable interest in and discussion about the desirability of occupational clustering as an organizational approach for shared-time vocational centers in Pennsylvania generally. While the approach is administratively attractive and logical, some vocational educators are concerned that opportunities for occupationally specific training will become watered down in favor of generic cluster skills that will be less acceptable to employers.

We did not observe vocational classes at DC Tech and thus have no information on clustering's impact in that arena. While the grouping of the school's vocational programs into four clusters was a first step in the change process, the major emphasis has been on using this mechanism as a vehicle for creating integrated academic and vocational teaching teams.

Philosophy of the Program

In the early 1980s, DC Tech administrators were concerned about the low academic achievement levels of the school's students. Entry and exit tests indicated that students made little progress during their three years of high school education. Furthermore, many students dropped out in frustration or boredom with their required academic courses. The administrators believed that by demonstrating stronger, more explicit links between academic and shop classes, they could change student attitudes and increase achievement.

People

As noted previously, the cluster program is the brainchild of the school's top two administrators. Their leadership as the project unfolded has been characterized by consistent commitment to the idea and a willingness to accept the gradualism with which change was taking place.

The school board has been very supportive of their efforts as are the local employers who sit on the vocational clusters' craft committees. These committees are often asked to review curriculum revisions for their relevance to employer needs.

Planning and Implementation Activities

Planning for the restructuring of curriculum and instruction was carried out over a two-year period. Vocational clustering was already in place. The next step was to involve the academic teachers in the cluster concept. When the assistant director came to DC Tech, there were 22 vocational teachers and a considerably greater number in the combined category of academic teachers and providers of "ancillary services." In any faculty voting situations, the vocational staff were always outnumbered, a fact that greatly increased the "us-them" dynamic. The decision to eliminate the departmental structure was at least in part an effort to overcome this structural dichotomy.

Academic teachers were assigned to clusters by fiat. Over the first five years of the innovation, no changes in team composition have been necessary.[2] During the planning stage, teachers worked within their cluster groups to begin the process of curriculum revision. Ideally, the administrators saw the cluster meetings as a replication of the "quality circles" concept, borrowed from the Japanese by American industry. Through regular opportunities for brainstorming and exchange of ideas among labor and management (teachers and administrators), the enterprise would prosper. As a result of early cluster meetings, the faculty agreed that the academic courses should adopt a competency-based approach to curriculum that would match the structure of the vocational curricula. The school arranged opportunities for inservice training in curriculum development and, more specifically, the competency-based approach. Furthermore, since the vocational programs had already implemented the competency-based curriculum design, vocational teachers were able to assist their academic peers in mastering this unfamiliar task.

In addition to curriculum working groups, cluster faculty also met periodically with their advisory committee members to verify skills that students would be expected to bring to the workplace.[3] Another set of monthly meetings during the planning stage was designed to begin the process of creating better understanding among academic and vocational teachers about the role that academic content can play in occupational preparation programs.

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[2] Six teachers have voluntarily left the school as a direct result of the planned or implemented changes.

[3] Each cluster has its own advisory committee in addition to an overall committee for the school.

Recognizing that some intermediate administrative structure was needed to replace the departments, the director and assistant director created the position of cluster manager. These individuals are elected by their peers and paid an annual stipend of $1,200 for shouldering added responsibilities such as helping the curriculum coordinator review texts and prepare the annual budget, chairing meetings, and, most importantly, acting as liaison between faculty and administrators. Arranging an extra preparation period for cluster managers has proven difficult to schedule. Therefore, most of their extra duties are performed outside the parameters of the normal school day.

In the second planning year, faculty zeroed in on the language arts curriculum. While no one disputes the importance of strong communications skills in the workplace, it is somewhat more difficult, at least on the surface, to make direct connections between the traditional high school English curriculum and vocational programs than it is to consider applied content in math or science. Ultimately, the goals of this planning and curriculum development activity were (1) to establish continuity in language arts instruction across the high school grades, and (2) to explore possibilities for integrating communications skills across the academic spectrum. More detail on the current status of the language arts curriculum is presented in the next section of the case study.

In subsequent years, the social studies curriculum was revised to include greater emphasis on the historical impact of technological advances, economics, psychology, and family living. Next year, the plan is to concentrate on better articulation between the various sciences and specific vocational clusters.

We attended an afterschool cluster meeting for the service cluster. Of the 13 member teachers, nine were present for the meeting, which was held in the health assistant program lab. Issues on the agenda included:

- the student-of-the month program
- school recruitment visits by the armed services
- tardiness
- scheduling
- club programs
- the senior prom
- the service cluster reward program
- the impending "retirement" of the incumbent cluster manager

Bearing in mind that this was the end of the school year with its attendant emphasis on both wrap-up activities and looking ahead to the fall, it seems clear that at this time, five years into the innovation, the cluster groups are not highly focused on matters related to curriculum and instruction. There was no discussion of curriculum development activities that might be taking place over the summer. In fact, with the exception of a brief reference to a new math or science requirement for distributive education students beginning next year, no topic on the docket was directly concerned with the content of education. Rather, the time was occupied with issues most accurately described as the affective side of schooling--

building student self-esteem, teenage pregnancy, attendance, and extracurricular activities. The assistant director commented that the original purposes of the quality circles needed to be "revived," a goal that he has internalized for the next school year.

Funding/Resources

During the planning stage for the innovation, DC Tech administrators applied for a curriculum development grant from the state. The money available for such grants appears to come from federal vocational curriculum development dollars allocated under the Perkins Act. The school relied on this funding (which amounted to about $40,000) to support inservice activities, updating books and materials, and teacher stipends. Its request for continued funding was denied for the current school year, and new resources are being sought.

III. Strategies for the Integration of Academic and Vocational Education

Curriculum

DC Tech hired its first full-time curriculum coordinator in 1982. This gentleman is one of the two school administrators who conceptualized and pushed through the decision to totally revamp the organization of instruction. He serves as both supervisor and resource person to all four clusters in the continuing effort to integrate academic and vocational content. Curricula are reviewed periodically by craft advisory committees in terms of their job relevance.

In order to graduate from high school, students at Dauphin County Tech must, over four years of high school, meet the following requirements in addition to their nine credits of vocational instruction:

Subject	Units
English	4
Math	3
Social studies	3
Science	3
Humanities	2
Health/physical education	1

No schoolwide course catalogue was available at the time we visited DC Tech. The descriptions of course offerings that follow are, therefore, based on conversations with teachers or administrators and do not reflect the total range of academic offerings in any one subject area.

English. Since 1985, English teachers at DC Tech have been gradually developing competency-based units of instruction.[4] The curriculum coordinator noted that English classes at the school have always been integrated with the vocational programs in terms of teaching specialized occupational vocabulary. Now, however, there is greater effort to identify generic "communications" competencies--i.e., in writing, reading, speaking, listening--needed for the workplace.

The keystone of the revised English curriculum is the required preparation of a technical paper about a vocational shop or lab procedure. Students begin this assignment in tenth grade and, in some instances, may continue to work on it throughout their three years of high school. When a report is completed, it must include a cover page, an outline of the contents, an information sheet (the body of the paper), a glossary, a quiz based on the material presented, and an answer key. Two examples of completed technical reports are attached to this case study--one developed by a welding student, the other by a student from the chemical technology program. Papers are critiqued and evaluated by both the English teacher and the relevant vocational instructor. Final products become part of the instructional materials for a given shop and may be used by the vocational instructors to train other students in subsequent years. Some students who complete this assignment with relative ease may go on to prepare a videotape for presenting the procedure to peers.

In addition to this major writing assignment, English classes require students to practice other types of business and lifeskills writing, read literature, and continue to develop spelling and vocabulary, much as in any high school English program.

Math. Teachers of other academic subjects believe that it has been easiest to realign the mathematics curriculum under the clustering plan. Even under the old system prior to clustering, vocational students took 120 hours (out of a total of 360) in technically related math. There were, therefore, textbooks and materials to draw upon.[5] In the cluster that we visited, math teachers appeared to rely most heavily on commercially published textbooks stressing business math.

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[4] It is interesting to note that in the document on which this description of the English curriculum is based, the curriculum development efforts described are ascribed to the "English Department." This seems to be an indication that in spite of the reorganization and official disbanding of departments, teachers of the same subject matter tend to continue to think of themselves as a disciplinary group.

[5] It should be noted that in Pennsylvania, if a vocational teacher can document that his vocational block provides students with 120 hours of instruction in English, math, or science concepts, students may use the course to meet a portion of their academic graduation requirements. They do not, however, receive an English, math, or science credit.

In addition to the efforts of the cluster-specific math teachers, one math teacher has been assigned to serve as a liaison with the vocational instructors. He is available to provide technical assistance or actual instruction in any vocational lab or shop on an ad hoc basis. Vocational teachers are required to remain in the shop as observers while this math teacher is working with students. The math teacher is available three to four periods per day, and after some initial reluctance, shop teachers have made good use of his services.

Science. Ninth graders take earth science in their sending districts before coming to DC Tech. At Tech, sophomores may choose biology or chemistry. Juniors in the more rigorous technology programs are offered the Principles of Technology curriculum package, while those in other programs take physical science. Advanced courses such as a second year of biology are reported to be available. Better integration of the sciences with vocational programs will be a major curriculum development objective at the school next year.

Social studies. DC Tech has laid out a social studies curriculum that stresses the historical impact of work, workers, and industrial/ technological advances, in addition to a good deal of emphasis on employability and independent living skills. Tenth graders take a course on the impact of technological changes, using a text about the seven most important inventions in history. The eleventh grade curriculum includes a semester of a course called the World of Work and a semester of economics, while seniors take psychology and family living.

Instructors

The instructors we interviewed were largely supportive of both the cluster concept and the efforts being made to align academic content with vocational program areas. Developing competency-based curriculum units has not been an easy task for some--particularly in English and social studies. A highly experienced social studies teacher told us that, in his opinion, the World of Work course offered to juniors naturally produces many opportunities for a teacher to draw students' attention to direct relationships between their vocational and academic studies. However, he finds that he must "stretch a point" to create such relationships in the history-based and economics classes that he teaches. This instructor is assigned to the service cluster and thus works with students from the cosmetology, health assistant, food service, distributive education, and horticulture programs.

An English teacher talked about one aspect of the new organization for instruction that is not directly related to content or presentation but has particular appeal for her. For the first time in her teaching career, she has had the opportunity to work with the same group of students for more than one year. She feels that this corollary of the cluster organization may do as much to improve students' attitudes toward and achievement in academic instruction as the curriculum reform itself. Over a two-year period, she is able to build a strong rapport and atmosphere of mutual trust with essentially wary students that are not usually possible in two semesters. The happy result is a considerably enhanced receptiveness among the students for things that are dear to her heart such as good literature and the ability to communicate well.

While teacher turnover is relatively low at DC Tech, a few new instructors are hired each year. Since implementation of the cluster approach, school administrators obviously make it a point to explain the philosophy and principles behind the school's organization and curriculum when prospective teachers are being interviewed. According to the curriculum coordinator, most candidates "grasp the concept right away." In some cases, this is apparently true. For example, a very young mathematics teacher--hired at mid-year to replace a teacher going on leave--reported that he immediately understood the common sense underlying the school's efforts to better integrate academic and vocational education. Unhappy with the lack of flexibility in the assigned textbook for his service cluster math students, he went to the school's repository for discarded texts and found another that he felt to be better suited to the occupationally related mathematics needs of his classes. In a separate conversation, the curriculum coordinator commented on this young man's initiative and contributions to the cluster in the very short period of time that he had been there.

In one case that we observed, however, another new teacher of science was clearly lost--struggling with the usual stress of first-year teaching but also without a clue about how to relate biology to the interests and career-related needs of his students. In late May, this teacher's cosmetology, health assistant, and food services students had just begun to study reptiles and amphibians and had not dealt with human biology at all. He has proceeded chapter by chapter through his assigned textbook that begins with amoebae and ends with zoology and, with two weeks of school to go, is about halfway through. We had the impression that much of his energy this year has gone into simply enduring. Despite an assigned mentor teacher and participation in cluster meetings, the concept of related academic instruction was the furthest thing from his mind.

Classroom Practices

We deliberately restricted our classroom observations to the academic classes of students in a single occupational cluster. The service cluster was selected because of scheduling constraints and because of our interest in observing how teachers handled curriculum integration in "typical" rather than "high tech" vocational programs. In the course of two days on campus, we visited nine classes, some of which are described below.

A twelfth grade English class for distributive education students was continuing its study of the play Our Town by reading Act II aloud. All the students participated in the reading, including two boys who frequently stumbled over the words. Later, we learned that the two boys were mainstreamed special education students.[6] The teacher deliberately reserves this particular piece of literature as a last assignment for seniors because of its direct relevance to issues confronting new graduates. She led the students into Act II through a discussion of its theme--love and marriage--in relationship to their own lives. In response to the question "Do you think just about everybody gets married?" one girl cited her psychology teacher's assertion that more and more people are staying single. A query about mother-daughter and father-son relationships in the play led to animated discussion based on personal experience. "Can you effectively give other people advice?" asked the instructor. The students agreed that in this context, parents were extremely contradictory creatures. "They tell you what to do all the time and then turn around and say you have to learn the hard way through experience."

In this class, we saw no direct relationship between the day's lesson plan and the students' vocational programs per se. There was, however, a definite purpose to the class that transcended study of literature for literature's sake--an objective that would have left these students cold. By personalizing the 40-year-old play, drawing out the universal and timeless themes of parent-child relationships, the teacher made the students forget that they were reading a required American "classic." Without resorting to direct exhortation, she was mentoring them, suggesting by allusion that they weigh their post-high school options carefully. Furthermore, while the students may not have made any connections between this English class and their distributive education curricula, at least one girl clearly demonstrated application of what she had learned in social studies to this discussion. In our experience of high school classrooms, such transference is a relatively rare phenomenon, indicating that there may indeed be above average coherence in cross-disciplinary curricula at DC Tech.

We also observed in an economics class for juniors in the service cluster. The lesson concerned a review of taxes--progressive, regressive, proportional--for an upcoming test. In eliciting or giving examples of the different types, the teacher was careful to illustrate to the students how these taxes affected their own lives. For example, there was considerable discussion of what types of items are taxable under Pennsylvania's proportional state sales tax. For the most part, clothing is not taxed. However, one girl pointed out that women's bathing suits are, a piece of information that she happened to have because of her afterschool job.

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[6] DC Tech serves approximately 100-130 special education students annually, including about 80 with learning disabilities. Other groups represented in the student body are a number of educable mentally retarded and lesser numbers of physically disabled and emotionally disturbed students. Although the school has a resource room that principally serves the emotionally disturbed youngsters, its basic philosophy is mainstreaming. This year, 22 of 26 handicapped seniors have held co-op work placements. Many I.E.P. students gravitate toward the machine trades, auto shop, construction trades, and food service programs.

Another boy swore that T-shirts are taxable. After much argument, the teacher asked him where he bought the T-shirts he had in mind. They were purchased at "the shore." "Then that's not in Pennsylvania," said the instructor, "unless they've moved the ocean!"

This social studies teacher told us that he finds it hard to relate economics to the students' vocational programs. Yet we observed several instances in this class where he very effectively showed students explicit relationships between course content and the workplace. For example, in a discussion of tariffs, he prodded the class to come up with reasons for imposing this type of tax since it raises relatively little revenue. Finally, they came to the realization that "it protects our jobs." At another point, he asked why the state gave the German-based Volkswagen company a tax break on establishing a plant in Pennsylvania. Through skillful questioning, he brought them to understand that the state wants to increase opportunities for employment.

It is possible that this particular instructor is defining "integration" of academic and vocational content more narrowly than we do--feeling that he should be relating economics to the students' specific vocational programs. This would be difficult in a class that includes students from cosmetology, health assisting, horticulture, etc. The more general work-related concepts that he imparted seemed to be entirely appropriate.

To some extent, English classes are "tracked" within clusters. We observed in what was described as a lower level sophomore English section where a large number of the students apparently are identified as special education students. As the end of the school year approached, several of the students in this class had not yet completed the technical writing project requirement. The teacher, therefore, was focusing her energies on these students while others rather half-heartedly worked on seatwork assignments. After some individualized conferences with several boys, four were selected to take their projects to the resource room to work with the reading specialist. The teacher then settled in with one boy from the food service program who seemed to be having particular difficulty with the report. His objective was to describe the procedures in a recipe and it was painful to watch him try to get words down on paper. Nevertheless, he persevered and no doubt had some type of final product by the day school ended. We wondered, however, about the utility of this requirement for all students, particularly when it requires a one-on-one instructional relationship to pull a single student through while others spin their wheels.

Evaluation

DC Tech has always used the 3-R's test to assess incoming sophomores' academic skills. Since implementation of the effort to integrate academic and vocational education in the clusters, this test has also been used for post-test purposes. Administrators report that students' math scores are up on the post-test, but language arts scores have gone down. They have not identified the cause of this phenomenon. Last year's seniors were the first group of students to go through a full three years of the program. The results of their post-testing will allow the school to take more careful stock of the impact of the innovation.

In developing a long-range plan in 1984, at the beginning of the clustering experiment, DC Tech administered the Educational Quality Assessment to all eleventh graders. This instrument tests students in 14 areas:

- self-esteem
- understanding others
- communications: reading comprehension
- communications: writing
- mathematics
- interest in school and learning
- societal responsibility
- knowledge of law/government
- health/safety practices
- creative activities
- career awareness
- appreciating human accomplishments
- knowledge of human accomplishments
- information use

The results placed the school's students in the 99 percentile in 10 of the areas measured, including all areas that can be considered directly academically related, when compared with scores normed only on students at area vocational technical schools. However, comparisons with students in comprehensive high schools indicated that DC Tech students scored low in communications, math, and information use.

The school conducted a one-year follow-up on the class of 1983 for its long-range plan. The results of this now somewhat dated survey are presented in Table 2. A survey of 1978 graduates five years after graduation indicated that 56 percent were working in their training area or a job related to their secondary vocational training. Only two percent of the respondents were unemployed. Thirty percent of these older graduates suggested that more high school work in mathematics would have helped them on the job; only 13 percent indicated that more English would have been useful.

Table 2

Follow-Up Survey of 1983 Graduates of
Dauphin County Technical School

Response category	Class of 1983[a] (in percent)
Employed, full time, related occupation	32.0
Employed, part time, related occupation	6.5
Employed, full time, unrelated occupation	14.0
Employed, part time, unrelated occupation	14.0
Unemployed	6.5
Further education	17.0[b]
Homemaker	2.0
Military	13.0

[a] Data based on a 51 percent response rate.
[b] May also be working part-time.

IV. Issues

DC Tech is committed to a highly ambitious undertaking. In contrast to some other programs that we visited, this school opted to introduce wholesale structural change in both organization and curricular approach on a schoolwide basis from the outset. The curriculum coordinator deprecates the dimensions of the effort: "There are no miracles here--just a reorganization and a requirement that all teachers do what the best teachers always did."

In many ways, however, this was a high-risk gamble, exponentially increasing the possibility of faculty sabotage or death through benign neglect as a single curriculum coordinator attempted to provide leadership and technical assistance in many places at once. In fact, the college professor who mentored the architects of the innovation counseled against the whole school approach during the planning stage, suggesting that a single cluster would be an appropriate place to start. At this point, however, five years into implementation, the gamble appears to be paying off. Those teachers who could not live with the innovation are gone and those who remain do not appear to be disenchanted. All in all, administrators and faculty have considerable reason for self-congratulation.

The way in which DC Tech has proceeded with its experiment raises several issues that might have bearing on any efforts to replicate what the school has accomplished. A number of discussion points are outlined below.

Curriculum and Instruction

DC Tech has chosen to bring its academic programs into the competency-based curriculum approach adopted at an earlier point by its vocational programs. Some teachers, particularly in the English and social studies areas, indicated that identification and articulation of appropriate related competencies in the academic subjects have been difficult and time consuming. It struck us that the problem may lie in the fact that teachers have really been asked to undertake two steps simultaneously: (1) to rethink the content that they have always taught in terms of its relationship to vocational training, and (2) to learn "the competency-based way."

Despite the fact that no serious deadlines have been imposed on the progress made, some pressure might have been removed by reserving implementation of the competency-based approach to academic subjects for a second phase. A more serious flaw in the approach taken by DC Tech may be that in some ways, a competency-based curriculum (CBC) is antithetical to the whole notion of applied academics. Most educators have been schooled in Bloom's taxonomy of educational objectives, which creates a hierarchy for learning. Breaking a subject down into its smallest parts is the quintessence of competencies. Application, on the other hand, may require combinations and recombinations of competencies that the CBC movement is not always sensitive to.

Time

The efforts made at DC Tech lead us, as in others of these case studies, into the issue of time. Originally, the experiment at DC Tech was conceived as a five-year plan. At the outset, this seemed to be ample time--longer than a presidential term or the funding cycles typically followed by governments or foundations. Today, however, the curriculum coordinator estimates that the innovation "is halfway there." In this instance, the goal or endpoint is somewhat vague, although everyone seems to have a sense that they are progressing toward something. Fortunately for this effort, the timeline is flexible. There is no threatened withdrawal of any type of support because some criterion has not been met. Given the complexity and scope of the undertaking, a 10-year planning and implementation calendar is probably realistic.

Teachers

Despite the fact that the innovation at DC Tech was instituted by fiat, the teachers we interviewed appear to be solidly behind the effort. This is counterintuitive to much of the literature about educational change and staff development, which asserts that teachers must need and feel "ownership" for any projected change before it can succeed. Here, teachers appear to have formed their commitment in the process of doing what administration had determined should be done. Over a five-year period, six teachers have left the school because they were uncomfortable with what was taking place. This does not seem to be serious attrition.

Because of the classes that we were scheduled to observe in this school, we became aware of a potential problem for this and similar efforts to restructure the relationship between academic and vocational education: the induction of newly hired teachers into a situation that differs radically from their previous experience in schools. The situations we witnessed here involved brand new teachers who came to their first teaching assignments armed only with their experiences as students or as student teachers in traditional settings. In one case, the innovation was taken in stride; in the other, the exigencies of preparing for day-to-day teaching overwhelmed any possibility of trying to comprehend how this school's approach to curriculum and instruction differed from others.

All schools and educational programs are required to accept and induct new personnel, if not annually then certainly regularly. When this happens midstream in a structural change, it seems to us that special provisions must be made to fully acclimate the newcomers to expectations that may differ from normal conditions. This would apply to experienced teachers as well as to novices. Otherwise, the total enterprise may be undermined over a relatively short period of time.

Students

We suspect that at this school and the others where we observed efforts to better integrate academic and vocational education, students and their parents have little concept of the curricular and instructional experiments that are taking place. At DC Tech, this impression was confirmed by a recent evaluation. An oral report to school administrators by a Middle States evaluation team indicated that students don't really understand the changes that have taken place at their school. This raises the issue of whether such innovations are strictly professional decisions or whether they represent such a radical departure from standard operating procedure that community and parental opinions should be part of the decision making process. To the extent that programs can demonstrate increased achievement or improved outcomes such as higher job placement rates, they are unlikely to make waves. If there is a dip in these outcomes during the early period of implementation, the innovation may be jeopardized.

Schenley High School Teacher Center
High Technology Magnet
Pittsburgh, Pennsylvania

Becky J. Hayward

I. Overview

The Setting

Pittsburgh, Pennsylvania, has a population of around 400,000, about one-fourth of which is black. Fifty-two percent of the students attending public schools in the city are black, and the district enrolls a small number of Hispanic and Asian students. About 85 percent of the district's students qualify for free or reduced-price lunch. According to school-district officials, enrollment declines have recently bottomed out, and the district is opening three new elementary schools in 1988.

Citywide, slightly over half of the high school students are enrolled in vocational programs; one-fourth are in academic curricula, and 22 percent are classified as general-track students. District officials believe that many of the general-track students will enter vocational programs next year when the district discontinues that option--they expect vocational enrollments to increase to about 70 percent of all secondary enrollments. The city has a cumulative dropout rate of around 28 percent. (Dropout rates are highest for general students and lowest for academic students.) About one-third of graduates go directly to college, and officials estimate that about 40 percent of vocational graduates eventually enroll in a formal postsecondary training program.

Schenley High School Teacher Center is one of 10 comprehensive high schools in Pittsburgh.[1] Historically a black high school, prior to 1983 approximately 80 percent of Schenley's enrollment was minority. Schenley was restructured as a magnet school under the city's voluntary desegregation plan, which was implemented in fall 1983. Under this plan three magnet programs were implemented at the school: a high technology magnet, an international studies program for academically talented students, and a health occupations concentration, which was subsequently moved to another high school. Additionally, the school was designated as the city's "Teacher Center," a strategy that involved assigning the system's best teachers to the high school in order to attract the mix of students necessary to meet desegregation goals.

The school's physical plant is an interesting triangular, three-story building, with a solarium in the center. It is an older school but very clean and well maintained. Throughout the building student work is on display, ranging from athletic trophies to art work to prize-winning projects developed by high tech and other students. The school boasts a satellite dish and sophisticated broadcasting equipment that are available to high tech as well as other students during their course of study.

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[1] The city also operates one vocational high school, two satellite secondary schools, and two special needs programs at the secondary level.

In 1987-88, Schenley enrolled around 1,100 of the city's approximately 14,000 public high school students. In addition to the high technology magnet we visited, the school offers the following vocational programs: home economics, dental assisting, drafting, machining and manufacturing, construction trades, and business. Welding and auto body are available to students at another location. As a comprehensive high school, Schenley offers the full complement of high school academic programs, including scholars and Centers for Advanced Studies (CAS) (a state-mandated program for gifted and talented students) curricula for academically talented students. As part of the desegregation plan, the school has employed recruiters to encourage nonminority students to enroll at the school.[2]

The High Technology Magnet

Established in fall 1983 as one of the programmatic strategies whose objective was to improve racial balance at Schenley, the high tech magnet was the "brain child" of the district's Associate Superintendent for Curriculum and Program Management. The program is an interdisciplinary, four-year curriculum that emphasizes integration of academic and vocational (or "technical," as it is called to minimize the stigma associated with vocational education) instruction in the teaching of advanced electronics. The program is organized into two "strands": (1) the professional strand, intended to prepare students for college in engineering or other technical fields; and (2) the technical strand, intended to prepare students for postsecondary vocational training or entry-level employment.

Program capacity is 80 students in each entering class, with slots to be divided equally between white and black students. At the time of our visit in spring 1988, the high tech magnet was about to graduate its second class, with 27 students nearing completion. Fourteen students graduated in 1987. Thus the program had not yet reached capacity, although the expectation is that the class entering in fall 1988 will be near the 80-student limit.

Entering ninth graders are accepted on a first-come, first-served basis, with students requesting admission later in their high school years selected following evaluation of their prior high school work. While the program does target academically talented students, the intent of the two strands is to attract students with a wide variety of interests and abilities rather than limiting enrollment to a single type of student.

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[2] The school is now about 60 percent black and has been granted an extension on its deadline for integration because of the progress made so far in terms of racial balance.

A substantially higher number of students typically enter in the ninth grade than complete the four years. A school official told us that the ninth grade is to some extent an "exploratory" period, when some students find that their interests are not consistent with the curriculum, some are unable to do the work necessary, and still others are recruited to other programs, particularly to the CAS international studies magnet also located at Schenley.

II. Development and Implementation of the High Tech Magnet

Origins and Philosophy of the Program

The immediate impetus for the high tech magnet, as well as for other innovations that have been implemented at Schenley in the past few years, was the district's need to achieve greater racial balance at Schenley (as well as at other schools in the city). More generally, however, over the past six or seven years the district has undertaken a number of initiatives whose overall intent is to improve all aspects of public education in the city.[3] Inspired in part by statewide educational reform mandates and in part by a dynamic school district administration, the high tech program is in some sense "new generation" vocational education, a change from the old style radio and TV repair courses that constitute the more traditional electronics curricula of many vocational students in Pittsburgh and elsewhere. (Program designers and implementors have attempted to stress this difference by insisting that the program be called "technical" rather than "vocational" education.)

The Associate Superintendent for Curriculum and Program Management conceived the high tech program based on a study he initiated to investigate the skill training needs of area businesses. The changing profile of industry and business in southwest Pennsylvania has brought over 240 high technology firms to the area. The Associate Superintendent decided to survey those firms specifically and undertake a Delphi study in order to determine whether the district should be implementing new types of vocational programs in high tech.

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[3] Among the other innovations currently underway are (1) a teacher retraining program under which all teachers in the district are participating in intensive, eight-week retraining under the tutelage of the corps of master teachers located at Schenley and elsewhere; (2) implementation of the "MAPS"--Monitoring Achievement in Pittsburgh--which involves development of prescribed competencies (and accompanying course guides and curricula) that students must demonstrate in all courses taught in the system; (3) dropping of the general track as an educational option for high schools students; and (4) establishment of a number of magnet programs and schools throughout the city.

Among the questions included in the survey were items asking employers what they will be looking for in workers five years from now. In some ways the results of the survey were surprising. First, respondents indicated that if the district were training for skill needs of five years hence, they would be missing the boat. Because of rapid changes in technology, skills will likely be obsolete by the time students have completed their training. Results of the survey, along with the recommendations of the Delphi panels, indicated that workers need computational and communications (including oral and written) skills and a work ethic. They need to learn these skills in the context of applications, not as abstract concepts. Thus they need to learn electronics, hydraulics, pneumatics, and the like, with their academic courses providing a basis for understanding the theories underlying the applications. In short, then, the vocational or technical content should drive the curriculum, and the academic content should be organized to support that content.

Based on these recommendations as well as on his own educational beliefs, the program's initiator commented that the "...real vocational program of the future will demand thinking skills, a facility with language, both written and oral, and computational skills." Further, "if education is to have meaning, it must be experiential." As one of the program's administrators commented, seeing things work, and making them work, is a better strategy for helping students learn things like Ohm's law than merely reading and discussing.

This is essentially the philosophy in which the high tech magnet is grounded: integrated, applications-based technical and academic training intended to teach theory as well as applications, and to enable students to think and solve problems, thus acquiring skills that they can use in diverse settings and potentially diverse professions or occupations. The program's developers and administrators believe that students who complete the program will know the theoretical bases--whether scientific or mathematical--of electronics at a level that is not available to students enrolled in a strictly academic or strictly vocational curriculum. They will have seen, and performed, the applications of the theories they learn in the classroom, and this experience will provide them with creative problem-solving skills that will put them a step ahead when they enter college engineering programs or postsecondary technical training or entry-level jobs.

Based on this philosophy, the program's specific goals include the following:

To prepare students

to understand the effects of the rapidly developing technologies on their lives and country

to be computer literate in a computerized world to assess their interests, aptitudes, and skills as consumers and developers of technology

to enter a multitude of technological vocations

It is important to note that most of the persons we interviewed who are involved with the high tech magnet acknowledge that the program does not prepare students for entry-level jobs in electronics. The logical next step for students completing the program is either college or postsecondary technical training (at a public or proprietary school, in the military, or perhaps on the job). Thus students who go immediately into jobs are not very likely to obtain a career-path job in electronics but rather may go into a related job that could eventually lead to further training and a career in that field. Interestingly, a substantial majority of the first two graduating classes have gone on to college.

Planning and Implementation

Following the decision to establish the high tech magnet, the Associate Superintendent, along with the Director of Occupational, Vocational, and Technical Education (OVT) and other teaching and administrative staff, formed a committee to plan the details of the program. This committee, whose membership included academic as well as vocational teachers and administrators, set the general direction of the program, working out details of academic and technical course offerings and sequences, selecting equipment, and making decisions about the shape the magnet would take.

Also involved in planning and development was an Advisory Committee drawn mainly from the private sector. Initially, the Advisory group was large and somewhat cumbersome. Subsequently, its size was reduced to seven persons whose initial and ongoing activities included an active level of support and advice relevant to the high tech program. The Advisory Committee reviews curriculum and makes suggestions for changes based on their expertise and provides advice and assistance as needed to ensure the success of the program.

Program implementation occurred sequentially over four years from 1983 through 1987, when the first class graduated. In each of these years academic and vocational teachers wrote curriculum for the following year's courses. During the first two years frequent "roundtable" meetings were scheduled for all teachers participating in the program. At the outset, these meetings included teachers and administrators involved in both the high tech and international studies magnets; later the two groups began to meet separately.

The chief purpose of the roundtables was to ensure the integration of the curriculum. Additionally, they provided a forum for discussion of specific issues regarding the program's implementation and direction and enabled teachers to address problems of individual students, plan field trips, and generally work out the details. Perhaps most importantly, they were a mechanism through which both "sides"--academic and vocational--could begin to get acquainted.[4]

In addition to roundtables, teachers visited and observed each others' classes, and academic teachers visited industry to observe operations. For example, an English teacher visited the technical writing department of an electronics firm in connection with development of the high tech English curriculum. All of these activities were intended to support the development of an articulated, integrated program that would serve the dual purposes of attracting students to Schenley and providing them with the tools to succeed after program completion.

As part of the program's ongoing implementation, curriculum revision activities are now under way. Teachers are working together to make modifications based on their experience of the program's first four years, and program administrators anticipate that in each of the second four years, one year of a course will be revised. Thus, program implementation is viewed as an ongoing process. Asked about institutionalization, administrators commented that while a number of teachers and school-level administrators have bought in, continuing support and oversight from district OVT staff are probably necessary to keep the program on track.

Critical People

As noted earlier, the Associate Superintendent for Curriculum and Program Management was a key person in the program's conception and early development. This person was described by several respondents as a dynamic and innovative educator who is eager to try new approaches to public education and is able to garner the financial and personnel resources and support necessary to implement those approaches. Even so, the day-to-day problems of implementing innovations can be a challenging and time-consuming activity for the administrators and teachers assigned to the task. This was apparently the case with the high tech magnet.

In the program's first few months, it lacked direction. Part of the problem was that the Schenley vice principal assigned to supervise the program was not entirely convinced of its appropriateness. A former English teacher, he was slow to accept the program as other than traditional vocational education, which at Schenley, as at a large proportion of the high schools in the nation, tended to be viewed as a dumping ground. Apparently his views, which were also shared by a number of the school's academic teachers assigned to the high tech magnet, have changed over time. Persons we interviewed attributed these changes in part to a re-education process that occurred through involvement with the Advisory Committee, all highly successful businessmen who were very enthusiastic about the program.

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[4] At Schenley as well as at many high schools in the nation, there is relatively little routine communication between academic and vocational teachers. At Schenley, in fact, they do not even eat in the same lunch room.

Early on, an OVT supervisor was assigned to take over the magnet and ensure its success. What he found has been characteristic of the program throughout its existence. In his experience, new programs always need a "glue person"--someone who can take charge and work out the problems. The first glue person was one of the electronics teachers. Together, this teacher and the OVT administrator established a process intended to "sell" the high tech magnet to its teachers, the school's administrators, parents, and others upon whom its success was thought to depend.

It is interesting that while the original glue person has since left the program for a district administrative position, there is a continuing commitment to the idea that the program, to succeed, must have someone in that role. The last glue person was an English teacher, and the current one is the business teacher who teaches high tech computer literacy but also does a great deal more for the magnet: arranging field trips, encouraging students to submit their work in contests, setting up teacher teaming activities to encourage cross-fertilization between the academic and vocational teachers, and generally serving as the program's energetic and committed advocate.

According to the persons we interviewed during our visit, there must be a glue person for this program to succeed. That person is to some extent self-selected, although our impression was that district administrators responsible for the magnet have some influence on who fills the role. Since a critical function of the glue person is to foster integration of academic and vocational components, in some sense it is better if the person is an academic teacher. The commitment implicit in filling the role may help to legitimize the program for academic teachers who are resistant to the idea of reconfiguring academic subjects in order to support a vocational, or even a technical, program in high school.

Funding

Now five years, old, the high tech magnet has been funded through a combination of school district and federal magnet funds. Its first two years were supported with local funds, the second two, with magnet school funds, and the fifth year with local funds. The district expects to continue the program with local funds. The program has not received any Perkins funding.

Prior to implementation in fall 1983, program planners spent approximately $160,000 to purchase equipment for the high tech labs. Other funds have been available for teachers to develop curriculum and engage in program planning, for student field trips, and other program-related activities. Additionally, private employers, particularly those represented on the program's Advisory Committee, have donated equipment, provided speakers, and provided opportunities for teachers, particularly the academic instructors, to observe their operations to facilitate development of courses and curricula.

III. Strategies for Integrating Academic and Vocational Content

As noted earlier, the high tech magnet is organized as two strands, with the professional strand leading to college and the technical to postsecondary vocational training or employment. Table 1 shows the course requirements for each of the strands. In the ninth grade, the curricula for the two strands are identical. The rationale for this arrangement is that students who enroll in the program at the ninth grade may change their minds (or not do well), and their freshman program should be sufficiently flexible to ensure that they can return to the regular program and still meet the requirements to graduate in four years.

After ninth grade, however, the professional and technical strands diverge, with the professional strand incorporating more electives to permit students to take such courses as foreign language in anticipation of entering college. The technical strand has no electives in grades 10 or 11, and the available electives for grade 12 are clearly less rigorous than those offered to potentially college-bound students. Finally, overall, college-bound students take fewer technical courses than do students enrolled in the technical strand.

Operationally, there appears to be substantially less differentiation between the two strands than program planners envisioned. Program administrators have been surprised that most of the students in the first two graduating classes have gone on to college, even though many of these students were officially enrolled in the technical strand. While this phenomenon is not viewed as problematic, or as a reason to rethink the program's dual focus, it does have at least potential implications. For example, as noted elsewhere in this discussion, parts of the curriculum are not unanimously viewed as appropriate for high school students, particularly for those who intend to go to college. Thus, if the program as it matures attracts primarily college-bound students, some rethinking of its structure may be necessary.

Curriculum

In Pittsburgh as in many localities throughout the nation, curriculum is written by teachers or other school district personnel. Most of the curriculum for the high tech course was written by the administrator who currently serves as the Trade and Industry supervisor in OVT. Formerly a machinist who taught machining for nearly 20 years, this person "...knew the equipment and guidelines" and so wrote the curriculum, including the outlines for the academic components.

As an illustration, the process worked as follows. Program designers at the district level established the philosophy and specifications for courses, and then teachers and supervisors were responsible for actual

Table 1

Outline of the High Tech Program
Schenley High School

Professional strand	Technical strand
Grade 9 (6 units)	
1 English (comp./tech wtg)	1 English (comp./tech wtg)
1 Social studies	1 Social studies
1 Science (electricity/mechanics)	1 Science (electricity/mechan)
1 Mathematics (Algebra 1)	1 Mathematics (Algebra 1)
1 Computer literacy	1 Computer literacy
1 Tech lab (electricity)	1 Tech lab (electricity)
Gym	Gym
Grade 10 (6.5 units)	
1 English	1 English
1 Science (pneumat./hydraulics)	1 Science (pneumat/hydraulics)
1 Mathematics (geometry)	1 Mathematics (geometry)
1 Tech lab (electronics)	1 Technical drawing
2 Electives*	2 Tech lab (electronics)
1/2 Technical drawing	1/2 Computers
1/2 Gym	1/2 Gym
*Social studies, biology, art, music, foreign language, computer programming	
Grade 11 (6.5 units)	
1 English	1 English
1 Social studies (US history)	1 Social studies (US history)
1 Science (adv. pneum/hydra)	1 Science (adv. pneum/hydra)
1 Mathematics (trigonometry)	1 Mathematics (trigonometry)
1 Tech lab (electronics)	2 Tech lab (electron/digital)
1/2 Computer-assisted design	1/2 Computer-assisted design
1/2 Gym	1/2 Gym
1 Elective*	
*Chemistry, art, music, foreign language, computer programming	
Grade 12 (6.5 units)	
1 English	1 English
1 Social studies (social issues)	1 Social studies (soc. issues)
1/2 Industrial mech/simulation	1/2 Industrial mech/simulation
1/2 Gym	1/2 Gym
4 Electives*	2 Tech lab
	2 Electives*
*TAS, calculus, foreign language, physics, art, music	*Science, art, music, math vocational

creation of the curriculum. Thus, for example, the decision was made that the English component would focus on technical writing, and teachers and supervisors were then responsible for developing a curriculum to teach "high tech" technical writing. Overall, the guiding principle was full integration of academic and technical components, with the academic, particularly English, math, and science, organized to support and reinforce the flow of the technical curriculum.

The program has not integrated social studies, which students take in regular classes with other students at Schenley. Thus, students are block rostered in all the high tech courses but not in social studies. Additionally, students' electives, particularly such courses as calculus or foreign languages, are not specified as "high tech" courses but rather are in the school's regular offerings. Arrangement of such electives around a student's block of high tech courses can sometimes be difficult.

What have been the implications of this approach to curriculum and instruction in the high tech magnet? Comments of teachers and administrators we interviewed during our visit provide illustrations of some of the issues relevant to academic-vocational integration as it operates on a day-to-day basis.

The conventional wisdom that math is probably easiest to integrate into a technical program is not entirely borne out in the Schenley experience. In part because of the MAPs, which require that all students achieve specified competencies in each of their math courses at milestones throughout the year, and in part because of the traditional way math (and most other subjects) is taught--in sequence, from simple to complex, from the first chapter to the last chapter of the book--it has been somewhat difficult to synchronize the math taught in math classes with the math skills needed in the tech labs. Thus the electronics texts and accompanying lab materials present many of the same mathematical concepts but in a different order. This has meant, first, that geometry has needed to be resequenced so that tenth graders are introduced to ratios and proportions earlier in the year than is typical in geometry. Further, teachers have sometimes had to overcome the conviction expressed by one math teacher: "But that's trigonometry; I teach geometry." Thus adjustments have been necessary in the typical across- and within-course order in which math has always been delivered in Pittsburgh: algebra 1, geometry, algebra 2, TAS (trigonometry, analytics, statistics).

In order to overcome these difficulties, curriculum writers developed math/science/electronics matrices covering the entire electronics curriculum and then worked together to rearrange the sequences in order to be sure that students were learning the same concepts at approximately the same time through their four years in the program. This revision has required some changing of attitudes, particularly among some of the math teachers, who have had to alter their standard way of delivering math to students.

Equally interesting is the incorporation of English into the high tech program. The program's recruiting brochure describes the English component of the program as follows:

> In addition to the standard objectives for each grade level, English classes in the High Tech Magnet include learning how to write precise directions and instructions, constructing flow charts and other diagrams, writing recommendation reports, feasibility studies, proposals, letters of application and resumes, and various other kinds of technical and business communications.
>
> Elements of short stories, poems, dramas, and novels will also be studied.

Conversations with English, business, and electronics teachers reveal both pluses and minuses in connection with high tech English. As noted earlier, program planners conceived technical writing skills as the logical content for high tech students, and the overall focus of instruction has been on this type of communication. In the ninth grade, students are introduced to technical writing, although for the most part the standard ninth grade curriculum is taught, primarily so that any students who "return to the mainstream" following ninth grade will have learned the same content as their nonhigh tech peers.

The ninth grade introduction to technical writing is perhaps the best example of good, interdisciplinary integration of the academic and vocational sides of the English curriculum. Students are assigned a writing project requiring that they describe the nature and workings of a piece of equipment (preferably but not necessarily electronic). Their compositions are checked for technical accuracy by their electronics lab instructor and for grammar and composition by their English instructor. The students then finalize the composition in computer lab, using the keyboarding and word processing skills they are learning in computer literacy class.

Starting in tenth grade, high tech English is mainly technical and business writing. The curriculum uses science fiction as a vehicle for teaching these skills, based on the notion that this type of literature has more technological theory and content than standard literature and will interest students who like electronics but not necessarily Shakespeare or Steinbeck. Additionally, students are assigned to write assembly and repair manuals, field reports, and other types of documents that program planners believe they will need to be able to write in whatever technical field they eventually enter.

In eleventh and twelfth grades, students receive the following mix. Partly because of MAP requirements, for one nine-week period students receive "regular" English. The second nine weeks are "interdisciplinary," following the pattern established for the ninth-grade project. For the remainder of the year, students write nine papers (one every two weeks), addressing nine topics that relate to their tech lab instruction. Thus, the high tech students are probably doing more writing than regular students in their last two years.

According to one English teacher, however, there are several problems with this approach. In her view, there is too much "space" in the eleventh and twelfth grade English curricula. That is, they have less "raw material" to use; consequently, they have less to write about. Further, many of the high tech students have skill deficits in vocabulary, grammar, and reading. According to this teacher, many of these students are good in mechanical drawing, are good with their hands, but not sufficiently skilled in reading and writing--they lack communication skills. In her view, this problem is exacerbated by the relative dearth of subjects about which to read and write.

Finally, the high tech students are not learning the American and English literature that many people believe are an important component of a high school education. On the other hand, not everyone shares the view that all persons must be exposed to that curriculum. In the view of the Associate Superintendent, for example, it may not be critical that all students read five Canterbury Tales before they leave high school. Learning doesn't end with a high school diploma, and students can learn these things later if they want to. What may be more important is to construct a program that will give students the skills and values they need to become productive citizens.

Instructors

A total of 11 teachers spend part or all of their time teaching high tech students. The two electronics teachers and one science teacher teach only high tech students. Those who teach both high tech and other students include four English teachers, two mathematics teachers, one business teacher, and one technical drawing/drafting instructor.

Teachers involved in the high tech program are not self-selected; they are assigned by school and program administrators. OVT program supervisors monitor their performance (and commitment), and those who are not following the curriculum or who resist the high tech philosophy are replaced. Further, according to administrators we interviewed, each new academic teacher who joins the high tech staff has to be "educated" about the program's philosophy and curricular approach. This is one activity in which the glue person is critical; essentially, that person tends to advocate for the program with teachers who may be skeptical about some of its components.

Generally, however, the teachers involved in the program are committed and enthusiastic. The instructor responsible for the ninth grade tech lab, an industrial arts teacher, is working to obtain vocational certification in electronics[5] in order to continue with his high tech assignment. The instructor for the eleventh and twelfth grade labs, who formerly worked in robotics at US Steel and before that was an art teacher, has been exempted from part of the electronics certification requirements. His enthusiasm for his teaching was evident as he demonstrated some of the creative work his students were doing in lab, and he expressed very high expectations for the post-high school options that the program opens up for graduates. He commented that he works closely with the math teachers--formally once a month but often much more frequently--to align the electronics and math curricula. Thus, in his view, academic-vocational integration is working well, and is providing students with a theoretical grounding and problem-solving skills that are the measure of good education.

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[5] The state requires that teachers have vocational certification in order for districts to receive reimbursement if they are teaching vocational (as opposed to industrial arts) subjects.

The glue person, a business teacher who had just received a teaching award from the National Science-Technology Association, talked enthusiastically about the extracurricular activities of the high tech students. One had recently won a national award for invention of a talking-teaching watch; others had recently won awards in an essay contest on energy conservation sponsored by Schenley's business partner, Duquesne Light; and seven students had contributed to Schenley's winning first place in the Junior Engineering Technical Society's annual competition.

In general, then, the teachers we interviewed exhibited commitment, enthusiasm, and competence. It is likely that the teacher selection process maximizes the likelihood that high tech teachers will exhibit these qualities. Additionally, the designation of Schenley as the district's Teacher Center has meant that the faculty at the school is probably, overall, the best in the city.[6] Under the district's comprehensive teacher retraining program, which has been under way for several years, these teachers have been serving as master teachers, actively engaged in helping their colleagues improve their teaching skills. Thus they are operating in an atmosphere that can be expected to foster a high level of commitment and enthusiasm for educational quality.

Classroom Practices

The tech labs at Schenley are clean, orderly, and well equipped. According to the ninth grade instructor, students in the high tech program are different--they want to be there, and this attitude is reflected in their behavior and engagement. He perceives the difference about midway through the students' first year, when they begin to be seriously interested in what they are doing. Discipline problems decline in number, and students begin to "turn on," becoming more interested in the why's and wherefore's of electricity and electronics.

This instructor's perception was reflected in his students' behavior. They were finishing up their last project for the year, and most students were working quietly in groups, once in a while interrupting our conversation to ask questions or show their instructor that something had worked they way they planned.

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[6] Designation of Schenley as the Teacher Center was at least partly intended as a strategy to help improve the school's racial balance under the desegregation agreement. The idea was that students would find the school attractive because of its excellent faculty.

We had much the same impression in the senior tech lab, where students were programming robotic arms, doing work with lasers, and working on a variety of electronic trainers. These students were working largely independently, and seemed sufficiently engaged in their tasks as to be oblivious to our presence.

The ninth grade science class, on the other hand, was somewhat rowdier, an observation that our escort attributed to the time of year (end of school), the weather, and the reality of 15-year-olds. Even so, the principles of concave and convex lenses that the teacher was going over on the blackboard were clearly interesting to about two-thirds of the class, and the teacher was leading these students into understanding the lesson rather than merely telling them the answers to the questions he posed. Additionally, he made frequent reference to their work in the tech lab, talking about the application of theories to the types of material they were covering in the lab.

Evaluation

When asked about program outcomes, most of our respondents acknowledged that they have not implemented any systematic achievement-related or outcome-related strategies to determine how well the program is doing. Pennsylvania does conduct a 12-month follow-up on all vocational graduates, and districts are required to achieve an 80 percent success rate (employment or postsecondary training) for state reimbursement purposes. One administrator commented, however, that the response rate is always low, although teachers can report with fair accuracy on what happens to their students.

It is interesting that when asked how they assess the program's effectiveness, most respondents offered process measures. There seemed to be relatively little concern that the high tech magnet has experienced an apparently low completion rate among students. For example, only 14 of the first entering class of 54 students completed the program, and 27 of the second entering class of 60 students remained for four years. They expect to graduate 34 from the third class of 76 students.

In this connection, however, it is important to remember that one of the purposes of the high tech magnet is to improve Schenley's racial balance by attracting white students to the school. According to program administrators, each year a relatively large number of students, particularly those who are academically talented, who enter the program leave high tech but remain at Schenley, often entering the International Studies magnet for academically talented students. This causes OVT administrators concern, and some resentment, since in their view, the administration's position is that "the goal is to integrate Schenley, so if the kid stays at the school, there's no beef." In their view, at least some of the school's guidance counselors encourage some students to leave the high tech program (which is, after all, vocational education even if it is enriched vocational education) in favor of an academic curriculum such as International Studies or another option in the CAS program.

The chief "hard" evidence offered for the success of the program was student-reported intentions following graduation. Of the 27 students expected to graduate in 1988, 15 (55 percent)[7] were planning to enter a four-year college. Only five of these were entering a program related to electronics, however. An additional four students were enrolling in a postsecondary proprietary school (marine biology, pilot school, drafting, and business automation). Three were entering the military, three were going to work, and two were undecided.

At the same time, in each of the program's five years, both initial enrollments and completion rates have increased, and administrators believe that the program will soon reach capacity. Further, they believe that students entering the program have a better sense of what they are getting into, principally because of ongoing improvements in the recruitment process. While in the first year a robot was used as a recruitment strategy--resulting in a number of students' becoming disenchanted when they realized that the program was hard work--more recently they have developed materials that describe the program's challenges and difficulties more realistically. Additionally, counselors discuss the program with parents of students who express an interest. One indicator of the program's quality, therefore, may be its steadily increasing popularity among Pittsburgh's students and their parents.

IV. Issues

It is obvious that implementation of "new generation" vocational programs at the secondary level is a challenging and sometimes arduous process. The key actors in the Schenley high tech magnet have clearly worked hard to solve the problems, and they are rightly pleased with the progress they have made. At the same time, their experiences, as they prepare to enter the program's sixth year in fall 1988, suggest some issues that merit consideration, particularly to the extent that efforts to integrate academic and vocational education at the secondary level become increasingly widespread.

Integration of Academic and Vocational Components

While a great deal of careful thought and work has been spent on integrating the academic and vocational components of the high tech magnet, it is clear that accomplishing this integration is an ongoing challenge. The strategy of changing the name--from vocational to technical--has not been entirely successful in removing the stigma that vocational education bears. In fact, the apparent competition for brighter students within Schenley suggests that not everyone has bought the idea that vocational education under any name is an appropriate pursuit for academically talented students. The implications of this view in terms of curriculum integration are important to program planners and administrators in that the attempt to change attitudes on both sides is key to program success.

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[7] It is interesting that one of the English teachers we interviewed believes that only about one-third of the high tech students are "college-bound."

It is clear at Schenley that a number of teachers on both sides have become convinced of the efficacy of the high tech approach. At the same time, the "buy in" is not uniform. To the extent that students are recruited away from high tech into CAS or International Studies, the stigma associated with vocational education is still alive, regardless of whether the program is called technical or vocational, and may ultimately be detrimental to the health of the program. In this context, it is interesting that one respondent commented that the fault is not all on the side of the academic teachers. Vocational teachers often retreat into a "to hell with them" stance, which further complicates attempts to integrate academic and vocational education into a high-quality, new generation vocational curriculum.

Program Goals

Implementation of "enriched" vocational magnet programs as a strategy to attract students in order to achieve racial balance is not new, but it is perhaps appropriate to point out some of the potential issues that require attention as districts work out the details of these programs. The requirement that the high tech magnet at Schenley reflect a 50-50 racial split means that program administrators have no control over student selection at the ninth grade. At the same time, they are under pressure to make the program succeed. The result has been that the program admits a number of students each year who are not well suited for the curriculum (because of interest, ability, and other factors that are difficult to control). This lack of fit is reflected in the program's relatively low completion rate, as well as in a lack of commitment to the program among some of the teachers and administrators.

The two-strand structure of the program was to some extent designed to accommodate this reality, but in practice, a substantially larger number of completers than expected has turned out to be college bound. These factors, in combination, have the potential to cause difficulties. In the first place, it is difficult to plan for a certain number of students and then have many of them drop out after the first year. Second, given the level of interdisciplinary coordination necessary for the program to work, it is probably important to have a good sense of what the students' strengths and weaknesses are. This is particularly apparent in the English component. It may be that the goals of the program need clarification to ensure that all of the program's components work cohesively to ensure the type of high-quality technical preparation that the program's developers envisioned. Ultimately, it appears that the program should probably do away with the two-strand approach and acknowledge that this is a college-track vocational-technical program.

Evaluation

Many of these issues could be clarified through careful, ongoing assessment of the progress and outcomes of students. It was not clear that any follow-up was conducted with students who left the program, and analysis of patterns among such students might provide useful information for program modification, not only in determining the efficacy of the dual strands but in decisions concerning supports that students may need to increase overall retention rates. Further, some of the curriculum-related issues mentioned by our respondents bear investigation in the context of potential revisions in content and delivery mechanisms. As with many educational innovations, ongoing monitoring and evaluation would likely yield significant returns for the long-term health of the innovation.

Oakland Technical High School - Health Academy
Oakland, California

Rosalind Hamar

I. Overview

The Health Academy, founded at Oakland Technical High School in 1985, is a school-within-a-school designed as a replication of the successful Philadelphia and Peninsula Academy models. Oakland Tech itself is a comprehensive high school with an enrollment of 1,600 students. By its own description, "Tech" is in the second phase of a major revitalization process, begun in 1983 when students and faculty returned, after earthquake-proofing, to a renovated building. The early phase of reform involved establishing schoolwide goals and objectives and achieving the status of a viable comprehensive high school. The current phase is focused on "raising student expectations and accomplishments." Within this context, the Health Academy is the first of what the principal hopes will eventually be five academies at the school, offering a high-level academic curriculum integrated into specific job training fields.

The Oakland School District, which serves 55,000 students, is one of the poorest in California. In fact, five years ago the district was portrayed by the University of California-Berkeley in The Guthrie Report as "the worst school system" the author had seen in 19 years. The community served by Oakland Technical High School is an inner-city area with a predominantly black population at the upper end of the low-income scale. Approximately 35 percent of families in the area qualify for AFDC assistance. The average dropout rate in the district is close to 40 percent and is somewhat higher for black males. It is also an area where teenage pregnancy is high and, according to the Health Academy program director, "drug dealing is an attractive career alternative" for many young people.

Like the programs it replicates, the Oakland Health Academy has been formed as a partnership between business/industry and the school, with the intent of providing a promising alternative for at-risk youth who might otherwise drop out of school or simply drift into post-high school unemployment, or early parenthood and welfare. The goal of the Academy is to attract a full range of under-achieving, educationally disadvantaged youth and provide an academic environment where their self-esteem can be nurtured; where they can have opportunities to explore community careers in the health field; and where they can acquire the knowledge and skills that will enable them to attend a postsecondary institution or secure a skilled entry-level job upon graduation.

Students who are interested and qualify can enroll in the Academy at the beginning of 10th grade. To qualify they must meet the at-risk criteria, be recommended by their teachers, be not more than three grade levels behind in basic skills, and have an interest in the health/medical field. If accepted, they will spend the next three years in an intensive college preparatory academic/technical program where (1) class sizes are relatively small; (2) block scheduling fosters a close "family" environment among staff and students; (3) the local health care community becomes an extension of the classroom; and (4) high expectations are coupled with plenty of individual help to enable students to succeed.

This is the third year of full operation of the Academy, and the first class of seniors has just graduated. According to the program director, of the original 42 sophomores who entered the program in 1985, 41 will either graduate or have moved out of the Bay area. Twenty of these graduates have been accepted by the University of California (at Berkeley and Davis), 12 others will attend local junior colleges, and seven have full-time jobs. Many of the college-bound seniors will have part-time jobs in the health field while attending school. Of the remaining three program starters, two have left the Bay area, and one dropped out of the program due to a pregnancy (but is still in school). These statistics are particularly significant since on entrance to the program, all but one of the first cohort tested below the 50th percentile on the California Test of Basic Skills and the average class ranking was at about the 30th percentile.

For those going on to college, the director's prediction is that they will do "OK to very well" academically, but may encounter major barriers in terms of the limitations of their cultural experiences and the isolation they may feel as part of a large university outside of Oakland. (Many students have never traveled beyond the city boundaries.) Most will enroll in health- or science-related programs. One plans to enroll in engineering (out of an interest in equipment for preemies prompted by work at Children's Hospital), and one is entering a business program (due to inspiration from a mentor who is the administrator of a local hospital).

II. Development and Implementation of the Program

Origins

In 1982-83 the California State Legislature made funds available across the state for replication of the successful Peninsula Academies Model. At that time, the director of the Oakland Alliance, recognizing this as an excellent opportunity for the city, worked with members of the Alliance and with the Oakland School District Superintendent to identify the most promising career area for an academy.[1] Oakland simply did not have the computer and high tech industry to support an electronics program such as the ones on the Peninsula. However, the "Pill Hill" area in the city supported a number of large hospitals, several smaller private hospitals, and a college of nursing. Health care, therefore, seemed a natural direction, so the Alliance director used the proposal development process as a way to get to know the CEOs of these hospitals and engage them in the process of planning the Health Academy. Oakland Tech was chosen as a site because of its proximity to Pill Hill, because it had an existing ROP Health Occupations program,[2] and because of the enthusiastic leadership of the school's principal.[2]

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[1] The Oakland Alliance, formed in the early 1980s, brought together key leaders of higher education, business and public schools. Their primary agenda was to develop collaborative career transition programs for non-college bound youth.

The Alliance served as a "broker" in the early phases of start-up. It brought together the various parties, organized the Steering Committee, and scheduled and staffed regular planning meetings. By the time the program was ready to be launched, the school had assumed effective ownership, the Steering Committee was well established, and the Alliance faded out of the picture.

Goals of the Program

With some modifications, the philosophy underlying the Health Academy is true to the original Philadelphia/Peninsula models. The basic program goals are:

(1) to serve an educationally disadvantaged and largely minority population of students who may not be succeeding in traditional school programs, who may drop out, and who lack employable skills;

(2) to provide these students with a solid academic background, particularly in the areas of math and science, so they may successfully pursue postsecondary education and/or training, should they so desire;

(3) to meet the vocational training needs of such students for skilled and semi-skilled positions with local companies, and to satisfy partially the needs of employers for employees in the field of health care;

(4) to raise students' self-esteem and personal expectations so that they will be more likely to graduate from high school and go on to pursue quality postsecondary education/training and good careers in health, medicine, or biological sciences; and

(5) to confront the problem of youth unemployment among the target population and to establish a model for possible use in other schools, districts, and localities.

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[2] Regional Occupation Programs (ROP) are California vocational training programs sometimes housed in separate vocational-technical centers and sometimes located in comprehensive high schools.

The college preparatory focus of the Health Academy is not a feature of all of the other academies. It was deemed essential in Oakland because of the rapidly evolving nature of the health care industry and the realization that the local labor market for those in this field will likely bypass persons who do not have some kind of postsecondary training.

Strategies adopted to accomplish program goals include the following:

(1) ensuring smaller classes--26 students in an average class versus 33 for school as a whole;

(2) integrating a demanding college-track academic program with vocational skills training and ensuring student success by providing numerous hands-on learning experiences and substantial tutorial support for those who need it;

(3) following block scheduling that allows students to become part of a smaller community within the school where staff and students know each other well and provide one another with a supportive network that becomes almost a second family;

(4) introducing students to the field of health care through field trips to hospitals and related businesses, guest speakers, a mentor program, and industry-loaned instructors;

(5) expanding students' cultural horizons by taking them to events and experiences outside the Oakland area;

(6) providing students with internships and jobs with local hospitals and other employers in the health care industry; and

(7) involving parents through frequent contacts and activities.

People

The Health Academy staff consists of the program director, who also teaches the English classes, and eight other teachers, almost all of whom teach a combination of Academy and regular classes. The staffing is equivalent to approximately 3.0 full-time equivalents (FTE).

As previously mentioned, the principal of Oakland Tech is an enthusiastic supporter of the Health Academy program, and this is an essential component of its success. Block scheduling requirements, the frequency of off-campus activities, and the high profile and special benefits the program enjoys are all potential administrative problems. The principal provides the necessary administrative backup to minimize staff jealousy and resistance to cooperating with the program. The success of the Academy is integral to his vision for the school. Next year the school will have a Pre-Engineering Magnet Program, and over the next five years he hopes to install three additional special programs.

The principal hired the program director at the beginning of the planning phase to design, implement, and run the program. The director has an English/social science background, and her teaching experience is combined with eight years on the staff of an educational cruise ship. She is a creative teacher and dynamic director with a remarkable ability to keep dozens of "balls up in the air" simultaneously. In addition to administering the program and managing its grants, she develops proposals for future supplementary funding; teaches the Academy English classes; provides support services to other teachers in the Academy; organizes all field trips, community activities, mentorships, and job placements; generates community support and contributions; supervises the tutorial programs; facilitates linkages with University of California and other local postsecondary institutions; knows all of the students on a personal basis; and has regular contact with their parents. Academy students and teachers recognize her as the inspiration and source of energy behind the program. When students were asked about the director's role they made the following comments:

> If [she] went to another school the program would go on..., but it wouldn't be as good....she makes sure we have the best.
>
> She is a personal type teacher....she puts the program and the students before her personal life....she is very determined and dedicated....she even comes to school when she is ill!
>
> She inspires you to go for what you want to go for...even outside the health field....she can help you with family problems....she is really a friend....

While it is fair to say that she is the "hero" of the program, she is also very cognizant of the need to share the program's benefits and responsibilities with other members of the Academy staff and other teachers at Tech. For this reason, she "manages by walking around," giving Academy teachers a great deal of support (getting special supplies for them, helping them adapt their teaching styles to the particular needs of Academy students, and ensuring plenty of positive recognition for their roles in the program). She also provides inservice programs for both Academy and non-Academy teachers, often tempting them to attend by preparing dinners for participants. She shares the nonconsumable assets of her program with other members of the school's staff (i.e., computers, software, and lab equipment) and collaborates wherever possible with other programs like the ongoing ROP Health Occupations program.

The director also works toward sharing the responsibility for running the program by rotating the responsibility for chairing planning meetings and by moving to set up a co-directorship with the Academy biology lab teacher for next year.

Community Support

Organizations and institutions involved with the Health Academy seem committed and willing to contribute to the program's success in a number of ways. In addition to in-kind donations of supplies and equipment, they also commit staff time and expertise to working with Academy students and open their facilities for on-site activities ranging from field trips to internships and jobs. As companies come to know the program through their initial participation, they often find additional ways to help out. For example, Cutter Laboratories has provided guest speakers and some good job commitments ($12 per hour for students with good chemistry backgrounds) to the Academy and this summer has offered to allow the program director and the chemistry teacher to go through their warehouse and select needed supplies and equipment from their surplus stocks.

Peralta College plans to bring several of its introductory classes onto the Oakland Tech campus next year for Academy students, so that they can receive concurrent credit at both institutions and have advanced standing upon high school graduation in Peralta's EMT and Medical Assistant training programs. Next year the program will also have the part-time services of a woman who will work to further develop community resources and administer the project's California Academic Partnership Program (CAPP) grant (further described in Funding/Resources section of this case study). Only 40 percent of her full-time effort is assigned to the Academy, while the other 60 percent is divided between Samuel Merritt College of Nursing and Black Health Network.[3] However, all of her responsibilities are focused on the same goal: getting more black students into postsecondary training and jobs in the health field.

Other community organizations that provide ongoing program support for the Oakland program include The American Red Cross, the 4-H affiliated with University of California at Berkeley, the YMCA, and Kaiser Hospital/ Foundation.

Planning Activities

During the six-month planning period, the Steering Committee met monthly to work with the program director in shaping the philosophy and overall goals of the program, establishing priorities, suggesting activities, and identifying community resources that could be brought in to support the Academy. These efforts also served to strengthen the partnership between the Academy and the business community and to broaden the school's health care industry network.

Teachers who would participate in the first year of the Academy were recruited from the staff at Oakland Tech in March and April of 1984. Some teachers were reluctant to volunteer for the program and had to be coaxed into participating. For instance, no math teachers responded to the initial appeal. Therefore, the principal and program director made a special approach to a popular first-year math teacher, who finally decided to join the program and is now a strong supporter.

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[3] The Black Health Network is a community organization with strong interest in promoting black participation in health careers.

At the school, all teachers who were to be involved in the Academy began voluntarily meeting on a regular basis during spring of the six-month planning period. Their work involved translating the ideas and suggestions of the Steering Committee members into specific program objectives and a fully articulated curriculum. They focused their efforts on designing a coordinated curriculum and mapping out all of the subject areas for the first year so that units within English, math, and the sciences would relate to health careers, build logically upon one another, and reinforce both the academic and vocational thrusts of the program. During the summer, teachers were paid for continuing this planning effort and for developing needed instructional units. In addition, teachers used the spring and summer to line up almost all of their speakers and field trips for the first year.

Some examples of their curricular decisions were reflected in the teaching of "metrics" and "math for science" early in the year in order to prepare students for science labs. In biology, teachers decided to teach "reproduction" early because of the high teenage pregnancy rates in their school.

Implementation Schedule and Rationales

The planners established a three-year time frame for full implementation of the program. The original sophomore class comprised 42 students. Each subsequent year, an additional 50-55 students are recruited to enter as sophomores. The total program enrollment capacity is 150 students.

The program director makes recruitment presentations to 9th grade science classes. Teachers and counselors also recommend students to the Academy and these students are often individually recruited. Most students become interested in the Academy through word of mouth. Students who want to enroll are required to submit a written application and a letter of parental support. Selected students are then interviewed in small groups by teachers and senior Academy students (this is primarily done to increase student commitment to the program).

In the beginning, students were skeptical of the program and reluctant to sign up because it was new and different. Now that the program is well under way, Academy juniors and seniors are a part of the recruiting process. They help staff with presentations to prospective freshmen, sharing their experiences and explaining that although the program is demanding and they will have to work harder, it offers a wonderful and exciting opportunity. According to the program director, they are the Academy's best sales representatives. No student who has joined the program has ever opted out voluntarily.

The Academy is concerned that its program be perceived by the students as a privilege and not "a dumping ground." They therefore deliberately recruit a few students each year who are not "at risk" and who are high achievers, so that they can provide peer role models.

The increasing popularity of the program will require that the Academy establish a more formalized selection process. Until last year, the program was able to accept over 90 percent of those who applied. However, the growing success of all the Academy programs in the Bay Area has increased the number of applicants to the point that the directors will be meeting this summer to determine a formula for accepting students when applicants exceed the available slots.

The addition of one new class each year has given the Academy the ability to build the program in a logical way, using the summers as planning periods to prepare curricula for the new level. This has meant adding one new science component (class and lab) each year and expanding the community component from speakers and field trips to mentor experiences, summer jobs, advanced on-site academic training, and internships.

Implementation during year one was somewhat hampered by a teacher strike and by two murders on the campus. Despite these constraints and catastrophes, students in the Academy did very well academically. This helped the Academy to win support from other staff in Oakland Tech who initially may have been skeptical about the value of the program.

The program director believes that implementation is a continuous process of building and enhancing the program. She is constantly seeking new ways to create linkages with other organizations and institutions, additional resources that can be generated, and innovative strategies for improving instruction.

Funding/Resources

Funding for the planning and implementation phases of the program has been provided by the state of California under legislation to support replication of the Peninsula Academies models. The initial six-month planning grant for $25,000 was followed by a $50,000 implementation grant for each of the first three years. No federal money has been used.

District contributions have included: (1) planning time for the director and for teachers, and (2) remodeling the "headquarters" for the Academy (a large sunny classroom, conference room, library, and storage area carved out of the third floor attic). The district also picks up 2.0 FTEs of the program staffing to accommodate smaller class sizes and one planning period per day for the director.

Local industry has provided computer and laboratory equipment, supplies, mentors, and loaned instructors, in addition to making their facilities available for student tours and providing internship positions and jobs for Academy students.

The program director, an energetic resource developer/fund raiser, has successfully solicited many additional monetary and in-kind contributions to support the program. For instance, a three-year $165,000 grant was received last year from the California Academic Partnership Program (CAPP) to develop cooperative efforts between Oakland Tech and Samuel Merritt College of Nursing to improve secondary education with the intent of enhancing the abilities of students under-represented in local colleges and universities. This grant will fund a number of activities in support of the following goals:

(1) increasing student learning in math and science;

(2) strengthening science teaching at secondary and postsecondary levels;

(3) developing science teaching materials;

(4) increasing college admission and retention rates for targeted students; and

(5) evaluating, continuing, and disseminating project activities.

Collaborative activities will include staff training, curriculum development, increased parent activities, and pre-college/pre-career counseling.

Next year, the Center for Living Skills, a local organization that has been conducting leadership training at some of the Bay Area's more affluent schools, will be providing their training for Academy students. Their donated time will be matched with $5,000 funding from the Kaiser Foundation, $10,000 from the Clorox Foundation, and $2,000 from City Corps.

The supplemental grants are utilized to build in program features that will become institutionalized over the grant period so that their ongoing costs will become part of regular budgets. The state's long-term commitment to funding the program is secure for the foreseeable future. However, next year the program will be required to meet performance standards as part of its state funding formula. Under these new guidelines, to obtain the $67,500 level of funding, the Academy must have 80 per cent attendance and 70 students out of 120 must pass 90 percent of the credits they are attempting. The district provides the money at the first of the year and will then be reimbursed at a rate of $750 per student meeting the performance criteria. This means that Academy students cannot fail more than one semester course. In view of the school's average pass/fail record (60 percent of students fail math and 40 percent fail English), this is a daunting prospect.

Although the initial start-up costs for an Academy are high, the director points out that over time the incremental costs go down. In fact, in California a substantial portion of the cost of the Academy program can be made up in additional monies that come to the school due to increased "average daily attendance" (ADA) support from the state.

III. Strategies for Integration of Academic and Vocational Content

Curriculum

Students enrolled in the Health Academy are required to complete the same graduation requirements as non-Academy students plus additional math, science, and computer courses. Minimum graduation requirements at Oakland Tech include the following:

(1) a total of 22 Carnegie units of credit in grades 9-12, with at least 16 units earned in grades 10-12;

(2) a grade point average (GPA) of at least 1.70; and

(3) passing scores on district tests of proficiency in reading comprehension, writing, and mathematics.

Most students in the Health Academy are by definition "high risk" and have failed two or more classes as 9th graders. Even so, since the Academy program is considered college preparatory, students who enroll are strongly encouraged to maintain a GPA of at least 2.0.[4] Academy students have less room in their schedule for electives than do other Tech students, since they must take a heavier load of math and science. English, mathematics, and sciences are all included in the Health Academy program and taught by Academy teachers, whereas social studies, foreign languages, physical education, and electives are taken in the regular school program. The required units of credit are:

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[4] In Oakland Tech as a whole, only 600 out of 1,600 students earned GPAs of 2.0 or above during the first Fall marking period of 1988.

Regular Curriculum		Health Academy
English	4 units	4 units
Mathematics	2 units	3 units
Science	2 units	
Biology		2 units
Physiology		2 units
* Chemistry		2 units
Computers	0 units	.5 unit
Social Studies	3 units	3 units
** Foreign Language	1 unit	1 unit
P.E. or JROTC	3 units	1 unit
Electives	7 units	4 units

* or Advanced Health Occupations, or Physics
** or Visual/Performing Arts

The course of study for Academy students is organized as follows:

10th Grade: Academy biology, Academy biology lab & computer lab (or Academy physiology & lab), Academy math (levels vary according to ability), and Academy English

Social studies: world cultures

Community activities: field trips, guest speakers, cultural events, job explorations

11th Grade: Academy physiology, Academy physiology lab (or Academy chemistry), Academy math (levels vary), and Academy English/Drama

Social studies: U.S. history

Community activities: hospital field experiences, mentor experiences, community service, and summer jobs for students with teacher recommendations

12th Grade: Academy chemistry (or advanced health occupations or physics, or a science combination, or concurrent enrollment at UC or Peralta Colleges), Academy math (levels vary), and Academy English.

Social studies: American government/economics

Community activities: mentor experiences, community service, concurrent enrollment at junior colleges, college application and job search assistance

Individual students' programs vary depending upon interest and achievement. Gifted and Talented Education (GATE) and Honors credits are offered to those students who qualify.

Integration of Academic and Vocational Curriculum

Although no particular curriculum theory formally underlies the Academy approach to instruction, the program director says that in the computer, math, science, and health occupations components of the program units of instruction are designed to adhere to a competency-based or mastery learning model. Competencies are developed jointly by Academy staff, collaborating postsecondary institutions, and health industry partners. Emphasis on critical thinking skills, learning to learn, and development of the affective domain are of equal importance in curriculum planning. Every effort is made to "bring all students along" in every subject area. So far, no students have been turned out of the program for poor academic performance. When they are behind or having difficulty, they are given a great deal of support and, if necessary, encouraged to go to summer school. Academic probationary contracts are also successfully employed.

The curriculum for the Academy program has been articulated by the teachers so that units of study are offered in a coordinated and logical progression that is designed to provide students with basic skills and knowledge needed to tackle subsequent lessons across the four subject areas. Field trips and guest speakers are also planned to complement and reinforce units of study.

According to the director and teachers interviewed, the curriculum is not modified in the sense of being watered down or made simpler to accommodate students whose skills may be deficient. Instead, if students require additional help to understand a subject or master a skill, tutorial help is available from peers and from outside tutors (primarily UC-Berkeley students) who are available on a daily schedule at Tech. Because Health Academy students are motivated to succeed, and because of staff encouragement, they tend to make far greater use of tutorial services than other students.

Science. In the sciences, a hands-on, discovery approach is used, so that students experience frequent lab work, including dissections and experiments designed to reinforce their classroom learning. The amount of paper and pencil testing is reduced for Academy students, who are required to write more papers, complete projects, and demonstrate their understanding of concepts through hands-on applications. The physiology teacher commented that this approach would only work with the top 25 percent of his regular classes, but because the motivation is so high with Academy students, they are able to go far beyond the basics.

Mathematics. Pre-algebra, algebra, and geometry are offered in the Academy program. Concepts covered are the same as in courses offered to non-Academy students but are often targeted toward applications to laboratory work or other aspects of medical science. Students who wish to go on to higher levels of mathematics are encouraged to take advanced algebra, trigonometry, or calculus from the regular program.

English. Academy students cover the same literature as any college-track class. The director, who teaches the Academy English programs, believes that "good teaching equals enchantment," that "good humanities and literature experiences are extremely important for students," and that it is essential to allow for divergence in learning styles. She selects the literature and designs the related assignments to provide a sense of "fairness, choice, and growth" for her students. Students understand that when they go to college, people will assume they have read certain books. Many of her students, somewhat to their surprise, have actually found these books interesting and enjoyable. The director uses a variety of approaches to create motivation and interest in different pieces of literature. For instance, study of The Crucible was punctuated with research papers leading to debates and highly charged discussions. The Scarlet Letter was very successfully treated as a soap opera. Most importantly, the director believes that literature broadens the students' background and helps provide them with a "sense of compassion and the richness of human emotion....it helps them learn to deal with life issues" that they will confront in the health field and elsewhere.

Students keep journals/learning logs, and often discuss what they have learned from lessons, so that written and oral communication skills are developed constantly. Assignments frequently relate to work going on in other classes, including social studies.

Social studies. The Academy program is informally integrated into the social studies classes, even though these subjects are not officially part of the Academy. Thus while students are not block rostered in social studies, their overall schedule means that most Academy students end up in the same social studies classes, making coordination with these teachers very easy to accomplish. An exciting example of this coordination was under way this May, as Academy seniors prepared Peer Education Presentations on AIDS for delivery to Tech social studies classes. Training for these presentations was being conducted by the American Red Cross.

According to the director, the AIDS presentations were enormously successful. The Peer Education team eventually presented to other high schools in Oakland and to UC-Berkeley. Response was so favorable that the Red Cross has selected several of the presenters for summer training at their national convention in the Midwest. Additionally, Academy students will then train other young people to deliver the AIDS presentations at their own high schools and in other districts. The project also attracted the interest of research departments in several of the local hospitals, generating five summer research assistant positions for Academy students.

Advanced health occupations. This program is jointly offered by the Health Academy, the ROP Health Occupations program, and Kaiser Hospital. Although it is really the advanced ROP class, last year only three of 17 students were non-Academy. It involves one semester of academic preparatory training (laboratory, computer, terminology) and one semester of rotating short-term internships in different departments of the hospital.

Instructors

There are eight teachers participating in the Academy program, all by their own choice and nearly all with enthusiasm for the students and the program. They range widely in age and teaching experience.

All teachers who participated in the first year of the program were involved in planning and curriculum development efforts prior to first-year implementation. Those who have joined the program as it expands have been involved in ongoing curriculum development efforts in the summers and during the school year. This past summer, for instance, teachers participated in a three-week curriculum writing project to integrate publication of a "Teenage Health Journal" into next year's program. An interdisciplinary effort is planned. Research would be done in the science classes. Community resource people from Samuel Merritt Nursing College would help students check their facts. Writing and editing would be done in Academy English and the computers would be utilized for desk-top publishing of the Journal.

Teachers join the Academy staff voluntarily, knowing that it will mean longer hours and broader responsibilities in terms of working with the students and the program. For the most part, they are very enthusiastic supporters of the program and the students. They compare the students' attitudes quite favorably to attitudes of their regular students, saying that Academy students:

> are a pleasure to work with....they are motivated, not silly...they come in here wanting to work and I can count on them to be on-task
>
> are able to work in groups and help each other...unlike those in regular classes
>
> are not as tied to having regular structured "turn-in" homework assignments....they are willing to spend time working on projects and issues without tangible rewards....and they do a lot more than just the basics
>
> are more talkative, but they have so much more enthusiasm...and it is OK to "be a nerd"--to get good grades

Although there is potential for a fair amount of jealousy among non-Academy staff at the high school, little envy has materialized. The principal, Academy director, and Academy teachers all believed that other teachers were generally cooperative as reflected by their willingness to let students out of class for Academy field trips.

Staff development is an integral part of the program. For example, during May 1988 the Academy and the California Academic Partnership Program offered two free three-hour courses accompanied by light buffet suppers to both Academy and non-Academy teachers. Topics included:

ELECTRIFYING YOUR CLASSROOM PRESENTATIONS

A razzle-dazzle class on the latest in computer-video interface with creative and practical classroom applications

WRITING IN SCIENCE

What the research says about the importance of using writing in the teaching and learning of science, with creative and practical applications

The woman who runs Tech's Computer Center and teaches the Academy computer lab courses offers her facility for training teachers to make more and better use of computers in their instruction. Twelve teachers from Tech and the Academy were trained this past year to use the Computer Center as a student motivator, an aid for tutorials, and as an exciting supplement to their regular classroom instruction.

Since teachers volunteer for participation in the program, they bring to Academy classrooms a variety of methodological approaches to teaching. Some are less conducive than others to helping these particular students succeed. For example, a chemistry teacher observed during the site visit used a very traditional, lecture-dominated approach to delivering instruction. Additionally, her attitude was not as overwhelmingly supportive of the program as that of other teachers. Her expectations for students were also lower, as was her opinion of their abilities.

When asked about the problems this kind of teacher presents, the program director said that she believed that you had to start working with teachers at the point where they were and give them continuous support and encouragement to raise their expectations and to modify their teaching style. She also pointed out that the chemistry program was hampered by lack of a lab period (due to a scheduling snafu) that would allow more hands-on learning and reinforce the classroom instruction. In other words, although the director acknowledged the problem, her expectations for the teacher in question were still high. Next year when the lab is available, she believes that the instruction and attitude will both improve. She cited the example of another biology/physiology teacher who has made an almost 180 degree turnaround in her teaching style and supportiveness since she started with the program. This particular teacher, who told me herself that initially she had been reluctant to use less traditional approaches, will be co-directing the program next year.

Classroom Practices

Physiology lab. On the morning that I visited this lab, there were approximately 20 students gathered around tables in small groups of four or five, busily dissecting portions of a very large pig uterus. Each group had a worksheet with questions to be answered and they were intensely engaged in exploring their section of the pig uterus for embryonic piglets. The atmosphere was informal as the teacher circulated from group to group, giving them assistance, answering questions and helping with the overall count of piglets. Apparently the class had expected to get four or five small uteri to dissect and the single large one had been a surprise. The abundance of piglets was a further surprise and all were intrigued. Approximately 25 were ultimately accounted for. Students explained that they would also have to write a short paper comparing the pig uterus with a human uterus.

Physiology class. Approximately 20 students in this class were receiving a final briefing from a loaned instructor from the Oakland Men's Project prior to beginning their round of Peer Education AIDS Presentations. The instructor paced the front of the room, grilling students with the kinds of questions that they were likely to encounter:

> "If I am HIV positive and a mosquito bites me and then flies over and bites you can you get AIDS?"
>
> "If Janet is pregnant and contracts AIDS will her baby be born HIV positive?"
>
> "How can you tell if someone is HIV positive?"

Students provided answers to the questions and supplemented one another's answers for added explanation or clarity. Then they asked their guest instructor some of their own questions:

> "If a woman is pregnant and HIV positive, how can it be that her husband would test HIV negative?"
>
> "Can you explain again how the immune system operates with HIV?"

The entire session was one of high-level engagement and relative seriousness. Students had collections of handouts and reference material that they had been given at earlier sessions. They sometimes referred to these for answers to questions. They seemed to have a good general understanding of their subject and confidence in their ability to answer the hard questions that they would encounter.

Chemistry. As previously mentioned, the teacher of this class used a traditional didactic approach to instruction. She handed out chapter review worksheets and went through the items one by one, asking the class questions and writing the answers on the blackboard. Students were attentive but not highly engaged. Typical questions requiring rote recall included the following:

> " What is an electrolyte?
>
> " How does a solution of a strong electrolyte differ from a solution of a weak electrolyte?"

" What are the chi values for weak acids and strong acids?

For the most part, this teacher answered her own questions with diagrams and board notations after students provided partial answers. Students took notes and seemed to know some of the material, but the level of excitement I observed in other classes was noticeably missing. At one point a boy asked a question about Tums and Rolaids and how they would react in a solution. The level of class interest seemed to rise a bit as the teacher responded, but then she returned directly to the worksheet. The homework assignment was to outline the acid and base chapter.

This teacher feels that the Academy program includes too many interruptions for field trips, lectures, and other events. She believes that the caliber of students is lower than those in a regular class and that they are less motivated. "In general, Academy kids get poorer grades." She did feel that they needed more lab time, and since this year there was no full period lab every day, she was having to trade off between lab and lecture. Her final observation was that it is "a good program and has kept people in school, but it is too clannish."

Computer lab. The computer teacher is clearly one of the driving forces in the program. She has taken it upon herself to develop many ways for integrating Academy subject area instruction with computer assignments. Her classroom is filled with various kinds of computers, many of which have been donated by local hospitals. Academy students learn Dbase 3, Word Perfect, and MS DOS; they have access to the Academy computer room most of the day for working on assignments or just improving their computer skills. Although the computer class was not formally in session, students were working on computer tasks that were related to the health field: setting up patient files, organizing a surgical list, writing a paper for an Academy science class. The computer curriculum is competency-based and the instructor explained that she runs her program like a business, requiring students to "bill" her for grades on the basis of competencies mastered. She was very excited about the capacity the lab has and the new things that would be added next year: a modem hook-up with the Nursing College Hospital, video/computer capability which will allow students to do dissections on the computer if they prefer, and desk-top publishing capability with a Macintosh which will be used for the "Teenage Health Journal."

Mathematics. The math teacher, a young woman, was introduced to me as one of the most popular teachers in the building. She was administering a test to her students that period, so they were quietly working at their desks. This teacher is a strong supporter of the program and is very pleased at the progress Academy students are making with their math. When they enter as sophomores, many need a brush-up on general math skills before they tackle pre-algebra. As they progress through the program, most successfully take algebra and geometry and some students go on to higher levels of math. She credits the Academy program with really motivating these students and providing them with all the necessary tutoring to help them succeed.

Evaluation

Evaluation has been an important component of the Health Academy since its inception. Baseline data on student achievement, grades, attendance, and earned credits were gathered by the American Institutes of Research (AIR) under a three-year contract funded by Hewlett-Packard. This contract, subsequently transferred to PACE[5] at the University of California-Berkeley (UCB), School of Education, indicates that the average Academy student shows two-year's growth per year in reading and math skills.

In fact, the UCB evaluation of second-year results of the program (which was included in an evaluation of 10 replications of the Peninsula models) indicated that the Health Academy "produced statistically significant differences in favor of the Academy students on 12 outcomes, out of a possible 15." In comparison to measures of a control group at Oakland Tech, Academy students showed significantly improved attendance, more credits accumulated, higher GPA's, fewer courses failed, and lower probability of dropping out of school.

Out of the entire Oakland School District's 1987 graduating class, only 44 students were accepted by the University of California system. This year 20 students from the Health Academy alone have been accepted by the University. This is a very remarkable statistic.

Long-range evaluation of Oakland's Health and Media Academies is being conducted by the Far West Laboratory (FWL). They see the model as "important to the restructuring of secondary schools for two reasons. First, it accepts the range of ability found in a comprehensive high school and does not seek to cream the best students as do many magnet programs. Second, it provides an organizational model for decentralizing large high schools to make them more personal so that social bonding is more likely."

FWL evaluators will be looking primarily at the effects of the programs on students and teachers over a three-year period, using the independent evaluator's baseline data as a starting point. Their evaluation will document academic achievement of students; changes required of teachers by the Academy concept; adaptability of the program to other schools; and the mutual attractiveness of linkages between local business, community resources, and the school.

Dr. Larry Guthrie of the Far West Lab spoke highly of the program, saying that every time he has been over there to visit, the director seems to have tapped into new sources of funding and generated new resources. His conversations with students have generated uniformly positive feedback, and he noted that unlike the Oakland Media Academy, the Health Academy has a much higher level of teacher involvement in the program.

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[5] Policy Analysis of California Education (PACE)

IV. Issues

The Oakland Health Academy indeed appears to integrate vocational and academic content effectively. The program basically offers an academic curriculum with heavy emphasis on math and science and a strong health/medical science orientation well integrated into almost every academic area. The planning time spent articulating the health aspects of the curriculum, so that units in one subject would correspond to those being taught in another subject, laid a firm foundation for integration. This is reinforced by ongoing staff curriculum development efforts and inservice training programs.

From the standpoint of an outside observer, there are exciting things going on at the Health Academy. Students love the program and seem confident about themselves and their futures. If anything, a few may be overly optimistic about the professional levels they will achieve (surgeon, veterinarian), but they seem determined to pursue their goals.

In assessing the potential of this model to be successfully replicated in other settings, we must first acknowledge that the Health Academy itself is a successful replication of a proven model. The state legislature of California found the Peninsula programs to be a very promising approach and, with urging from the business community, passed a bill funding the 10-site replication effort (which included Oakland). The state's reported intent is ultimately to fund 200 academies.

However, the University of California's interim evaluation of the 10 replication sites indicates that after two years, only "three produced unambiguous evidence that Academy students performed better that the comparison group." They go on to cite the Oakland Academy as "the clear winner" in terms of more successful outcomes for students. These findings suggest that one must look beyond the model itself for key issues that determine the promise of its replication.

Leadership

Although the "hero factor" is often discounted as a critical element of successful program replication, this study of the Health Academy suggests that though it may not be "essential," it certainly contributes to the degree of success.

The Academy director would be very hard to duplicate or replace. She obviously is the dynamo that energizes the program and keeps it growing. It is impossible to discount the impact of her strong belief in the students and the program, her ability to generate commitment from other teachers, and her boundless efforts to enhance every aspect of the Academy. She is aware of the risks that attend being such a key figure and she wants the program to outlive her tenure as director. For these reasons, she does, as mentioned earlier, work to deepen staff involvement and to extend the leadership role to other teachers in the program. Even at that, many believe that the program would lose a great deal of its energy if she were to leave.

Dynamic vs Static Program Implementation

It would seem that a successfully demonstrated program model can serve either as an end goal for program implementors or as a starting place. When asked about the success of the Health Academy relative to other replication efforts, the program director commented that some of the other projects had a more limited view of what was required. She believes that the limited view assumes that the model prescribes all of the needed program elements and once they are in place the implementation is complete.

This raises the issue of the value of establishing new goals and milestones every year of a program's implementation, rather than assuming that the program will run and succeed when it is put on "auto pilot." If you always assume that you have room to grow and improve, your program may continue to have vitality, whereas if you assume that once a program is running, it will automatically continue, you may find down the road that it begins to "run out of gas."

Administrative Support

A model program like the Academy, installed in a school without full support of its principal, could encounter serious problems that would constrain its success. Scheduling can become a key factor potentially limiting the program. The Health Academy director cited another academy where the principal was not fully involved in the planning phase and therefore does not provide the administrative support necessary to arrange protected blocks of time for academy classes. With only two periods blocked for their classes, this effort to replicate the model is seriously impaired.

It is also possible that the school-within-a-school model could create a certain amount of jealousy among professional staff who are not a part of the program, but must often adjust their schedules to accommodate academy students. This tendency toward envy can be further fueled by the abundance of resources that the academy attracts. Strong and skilled administrative support can help to diffuse this threat by building a sense of "ownership" and participation among the entire school staff.

Staff Compatibility and Commitment

When staff are recruited from within an existing high school, they will bring to the program a wide range of teaching styles. Teachers in new programs often have to dramatically change their mind sets and their teaching habits. Some may have a hard time changing their instructional approach to meet the program's expectations effectively. In these instances a program administrator can work to "bring the teacher along," understanding that it may take time; or the teacher can be asked to opt out of the program. The time required to help a teacher change may penalize students in the short-run, while asking teachers to leave the program can create a lasting source of antipathy toward the program if the teacher stays in the school.

The Academy director believes that her program has a very strong influence on teachers, causing them to change dramatically. Contact with business professionals has a profound impact on the teachers' sense of professionalism. The reward of working with students over a three-year period and seeing them mature and succeed greatly increases teachers' positive feelings about students' potential and about the program. The strong curriculum and staff development aspects of the program provide the strategies and ideas necessary to help teachers adjust their classroom approach.

The questions are (1) how much of a heroic effort should be made to help teachers change; and (2) if they seem unable to change, how can programs provide ways for teachers to extricate themselves without creating hard feelings?

Student Expectations

The success of the Peninsula Academies is less surprising than the success of Oakland Health Academy since students begin the programs with vastly different basic skill levels. As previously noted, students at Oakland Academy tested in the 50th percentile in reading and math on the California Test of Basic Skills (CTBS); Peninsula Academy students tested in the 90th percentile. This differential notwithstanding, Health Academy students graduate at grade level and many go on to college.

When the program was originally planned for Oakland Tech, some administrators wanted to be more selective in recruiting students. The director disagreed and her view prevailed. They do recognize the beneficial effect of having some students in the program who are top students and can subtly provide peer role models, but most students are clearly at-risk under-achievers.

The director attributes much of her program's success to their high student expectations: "The components of the model are all right, but you have to allow for more excellence than it suggests." She believes that if you have high expectations of students and then help them respond in every way possible, they begin to believe in themselves--often for the first time--and they rise to the challenge. The concept of planning for the future is new to these students and it has a very positive influence, even when their goals seem far too inaccessible. "The entering sophomore who is two years behind in math and English and decides she wants to be a veterinarian may well surprise you over the next three years through sheer determination and effort."

The Health Academy's belief in high expectations is reflected in their math offerings (pre-algebra, algebra, and geometry), whereas some academies only offer "Academy Math." Oakland's students are struggling with math their sophomore year, and yet their mastery of the first course encourages them to go to algebra with confidence.

The influence of adult role models in the community is also viewed as critical because they take students seriously and enjoy working with them. Students love and often "can't get over" the fact that a successful professional would take that kind of time and interest in them. This boosts their confidence tremendously.

New York State Occupational Education Curriculum Revision
As Implemented At:
Livingston Junior High School, Albany, NY
Albany High School, Albany, NY
Shaker High School, Colonie, NY

Nancy E. Adelman

I. Overview

The New York State Occupational Education Plan

This case study differs from the other four in the series. It describes a statewide vocational curriculum revision effort and looks more specifically at its implementation in two high schools and one junior high. In contrast with Ohio's options plan (described in another case study), which encourages schools to integrate academic and vocational education by making different configurations of content delivery eligible for vocational funding, New York has standardized and mandated a new approach to occupational and technical education by designing and writing curricula in considerable detail.[1]

A basic tenet of the New York innovation is that preparation for the current and future workplace requires a melding of academic and occupational education. The revised curriculum, therefore, incorporates instructional units and encourages instructional strategies to develop students' communications, mathematics, and problem-solving skills. These aspects of the new approach are of particular interest in the context of our current research.

The changes in the occupational education program have occurred in the broader context of the Regent's Action Plan, which represents New York's response to educational concerns raised by the flurry of national reports earlier in the decade. The plan includes many mandates and even more strong recommendations on issues such as graduation requirements, competency testing, and generally increased rigor in secondary school programming. As in other states, these types of policy changes have had a negative impact on enrollments in occupational programs at the same time that the Division of Occupational Education Programs was planning and implementing its major curriculum overhaul.

Much of our description of the revised New York state occupational education curriculum is based on official documents. Fortunately for other states and localities that may be interested in the rationales, change processes, and implementation strategies employed, the state has done an admirable job of documenting each stage of progress.

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[1] In New York, "occupational education" is the preferred term, used as a synonym for vocational education.

The Communities and the Schools

In order to obtain some idea of how schools are accepting and implementing the new approach to occupational education, we visited two communities: Albany, the capital city; and Colonie, a suburb. Albany is a small city with a population of about 100,000. The tri-city area--Albany, Schenectady, Troy--supports a population of about two million and is growing. Albany has one comprehensive public high school, an occupational center, and an alternative school. Administrators estimate that as many as half of the high school-age youth in the city attend Catholic diocese schools.

We visited Albany High School, which has an enrollment of about 2,100 students. Schoolwide, about 65 percent of the students go on to some type of postsecondary education or training. The dropout rate is 5 percent annually and teenage pregnancy is an alarming statistic, much as it is all over the nation. The school offers business and office education, home economics, and technology education on campus. This past school year, 640 students were enrolled in home economics courses, while over 300 took technology education/industrial arts classes. Enrollments in the technology education area are reported to be on the rise. Albany High is about a block from the Occupational Center where students can take programs in the trades, health occupations, technical, and service areas.

We also spent time at Livingston Junior High School, one of the two junior highs in Albany. The school serves 420 students, of whom 60-65 percent are minority and about 75 percent are eligible for free lunch. Students are grouped into five "mini-schools," corresponding to the five color-coded wings of the building. English, math, social studies, and specialty teachers are assigned to each mini-school. This "family plan" is designed to ease the transition from elementary school to the larger junior high setting. Students in a wing receive their art, music, and physical education classes on a single day each week. The major subjects (including Introduction to Technology and Home and Career Skills) are taken four days per week.

Colonie, New York, is a suburb with a population larger than Albany's. At one time, it was "the" place to live in the tri-cities area. In more recent years, however, it has been in transition as the upper middle class moves to Saratoga County, where taxes are lower, and is replaced by city dwellers displaced by neighborhood gentrification trends.

The school we visited in Colonie--Shaker High School--continues to serve a solidly middle- to upper-income clientele. It enrolls 1,650 students in grades 9-12. Approximately 85 percent go on to postsecondary education. Shaker High offers courses in business education, home economics, and technology education. Administrators estimate that during their four years of high school, about 22 percent of the students enroll in one or more technology education courses and 13 percent take one or more classes in home economics. Most take such courses as a single elective and are not attempting to establish an occupational education sequence to meet graduation requirements. Each year, about 50 students enroll in occupational programs at the BOCES.[2]

II. Development and Implementation

Origins of the Program

The New York State Education Department began the process that ultimately resulted in a major revision of its occupational education curricula in 1981. The decision to review the status of vocational education in the state was principally predicated on perceptions about changing social and economic contexts for education and work--the evolution of the technological and information society, the growth of the service sector, America's place in a global economy, and demographic patterns and projections.

Philosophy of the Program

From the outset of the curriculum review and revision process, New York's educational leadership believed that the mission of vocational education was badly in need of redefinition to fit changing circumstances. They were convinced by the evidence around them that rather than attempting to prepare students for specific jobs, the new goal of occupational education must be to give students broad, transferable skills that are adaptable to many work situations. In order to achieve this new mission, occupational education must come to be characterized by:

- decreased emphasis on specialized training;
- increased allocation of resources to staff development and a decrease in expenditures for specialized equipment;
- increased emphasis on service and information occupations;
- closer coordination and integration of academic and vocational curricula.

New York conceives of occupational education as a continuum stretching across 12 or 13 years of schooling and including skills related to personal and career roles as well as entry-level job skills. A lengthy list of the purposes of occupational education, contained in a state document, includes the following goals that directly relate to the integration of academic and vocational education.

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[2] The Board of Cooperative Education Services (BOCES) is an intermediate service delivery organization providing vocational, technical, special education, and other services to multiple contributing school districts.

Students who complete a program of Occupational Education should have:

- acquired technological literacy (conceptual understanding of computers and communications systems);
- developed skill in the technical writing, reading, and mathematics pertaining to a specific occupational education instructional program;
- developed the ability to make practical application of acquired communication and computation skills;
- acquired knowledge of basic economic concepts.

Critical People

The individuals we interviewed generally agree that New York's Assistant Commissioner for Occupational and Continuing Education and the Director of the Division of Occupational Education Programs spearheaded the initiative to revamp the state's occupational programs. However, many people contributed to planning and implementing the statewide initiative. Initially, 1,200 people participated in regional meetings to brainstorm trends in both education and in business and industry. About 200 people--including representatives of business and industry, educational administrators, teachers, counselors, representatives of community colleges, and students--served voluntarily on program-specific committees to define purposes, identify competencies, and make recommendations. To facilitate the implementation phase, a cadre of teachers has been trained to provide technical assistance and inservice workshops to school districts as they undertake implementation.

Planning and Development Activities

The planning stage for New York's curriculum revision effort is referred to as the Futuring Project. Over a three-year period from 1981 to 1983, eight program-specific Instructional Futuring Committees met 10 times. Each committee consisted of 20 official members. In addition, a classroom teacher from each of the state's 13 education regions served ex officio as liaison between a given committee and the teachers in the trenches. A separate Administrative Committee addressed overarching issues that crosscut individual occupational program areas. By design, a representative of business and industry chaired each committee, with an educator as vice chair.

Within the committees, there was a deliberate division of labor. Business and industry representatives were charged with identifying the skills and competencies that workers will need in the future, while the educators considered the most effective delivery mechanisms. At the end of the third year of deliberations, the committees made the following recommendations:

- curricula should be packaged in small units (modules) that are easily revised or replaced as changing circumstances in the workplace dictate;
- all students in occupational education programs should be instructed in a set of identified core competencies related to personal development, social systems, information systems, resource management, and technology (these competencies appear as Figure 1);
- rather than support redundant instruction in these core competencies in each occupational program area, they should be integrated into a coordinated program required of all occupational education students;
- the state should establish minimum skills and competencies expected of all occupational education programs;
- an accountability system should be put in place;
- inservice training opportunities should be expanded to prepare teachers for carrying out new state mandates.

The Futuring Committees completed their work and their recommendations nearly simultaneously with approval of a "Regent's Proposed Action Plan" designed to clarify the goals of elementary and secondary education. Recommendations regarding the restructuring of occupational education were, therefore, incorporated into the larger proposed reform plan, which was approved in 1984. Beginning with the graduating class of 1989, high school students in New York are required to earn 18.5 units, including the following specific credits:

English	4 units
Social Studies	4 units
Mathematics	2 units
Science	2 units
Art or Music	1 unit
Health	1/2 unit
TOTAL	13.5 units

Candidates for the Regents (state program) diploma must also earn three units in a second language. Drawing on the combination of these required credits and their choices for a quite limited number of elective slots, students must also complete either two 3-unit sequences or one 5-unit sequence in (1) occupational education, (2) mathematics, (3) science, (4) art and/or music, or (5) a second language; or students may choose to complete one 3-unit sequence in one of the above areas plus a 5-unit sequence in English or social studies. Students first entering grade 9 in

Figure 1

CORE COMPETENCIES

These competencies have been identified as important for every graduate of an occupational education program.

1. Personal Development

    1. Personal Skills
    2. Self-concept
    3. Personal Appearance
    4. Health
    5. Use of Leisure Time
    6. Adaptability
    7. Decision Making
    8. Problem Solving
    9. Interpersonal Relations
    10. Social Skills
    11. Participation and Interaction with Groups and Organizations
    12. Leadership
    13. Career Awareness/Exploration/Information
    14. Goal Setting/Career and Education Planning
    15. Job Application
    16. Job Retention, Including Work Habits
    17. Job Progression and Change
    18. Employer and Employee Relations

II. Social Systems

    1. Economic Concepts
    2. Political Literacy
    3. Legal Literacy

III. Information Skills

    1. Verbal Communication
    2. Nonverbal Communication
    3. Listening
    4. Written Communication
    5. Reading Comprehension
    6. Computation
    7. Information Retrieval
    8. Dictating Communication Skills
    9. Keyboarding Skills
    10. Use of Information Systems

1988 and thereafter may not use two 3-unit sequences of occupational education to obtain a Regents diploma; all 5-unit sequences of occupational education must be employment-preparation sequences.

Compelled to move quickly by adoption of the Action Plan, the Division of Occupational Education Services moved ahead with implementation plans based on the recommendations of the Futuring Committees. The resulting outline for occupational education in grades 7-12 is described below.[3]

Grades 7 and 8: (students entering Grade 7 in 1986 and thereafter)

- Home and Career Skills (3/4 unit required by end of eighth grade)--includes "process" skills (decision making, problem solving, management), personal development, personal and family resource management, career planning.

- Introduction to Technology (1 unit required by end of eighth grade)--includes 10 modules. Stresses technological systems, mathematics and science concepts, societal implications of technology, communications skills, safety and health, psychomotor skills, career-related information, creative problem solving, and transfer of learning to new situations and experiences.

Grades 9 and 10: (beginning with the class of 1992)

- Introduction to Occupations (1 unit required of all students planning an occupational education sequence to meet graduation requirements)--includes two required modules (Personal Resource Management and Working Citizen). Schools or specific occupational programs may select two other modules from the list presented in Figure 1. Designed as a bridge from the junior high school requirements to more specialized occupational programs in the last two years of high school. Focuses on transferable skills, occupational awareness, job readiness, and preparation for broad career options. Modules incorporate competencies in math/science, communications, problem solving, human relations/leadership, career options, and use of technology. Encouraged at 9th or 10th grades but may be taken in grades 11 or 12. More than one unit may be earned in Introduction to Occupations modules if desired, but only one unit may be counted toward a sequence.

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[3] Under the Regents Action Plan, elementary schools are strongly encouraged to provide instruction in computer literacy (with an emphasis on mathematical applications) and in keyboarding as a part of the language arts curriculum. Students would thus enter the secondary years with skills traditionally taught in seventh through ninth grades.

Grades 11 and 12:

- Concentration in one or more occupational clusters, beginning with one or two unit core courses and branching into a more specific occupational specialty within a cluster. Successful completion yields sequence or sequences required for graduation.

In addition to the new occupational education courses described above, the Regents Action Plan allows students to use occupationally related courses (including business math) to meet state-mandated graduation requirements in math and science. Course outlines have been developed to help schools implement such classes, which would typically be second-year courses focusing on practical applications. In addition, credits awarded for completion of certain occupational education courses have been declared usable by students pursuing an occupational education sequence to satisfy specified academic education graduation requirements.

Figure 2

List of Introduction to Occupations Modules

The Working Citizen
Personal Resource Management
Human Relations/Decision Making
Human Development Careers/'Parenting
Introduction to Foods and Human Nutrition
Introduction to the Economics of Work
Basic Communication Skills
Keyboarding
Keyboarding Applications
Information Technology
Visual Communications
Introduction to Keeping Business Records
Introduction to Natural Resources
Basic Systems of Construction
Basic Systems of Manufacturing
Basic Systems of Transportation
Basic Systems of Energy
Basic Systems of Communication
Basic Mechanical Principles and Skills
Basic Mechanical Maintenance and Service Practices
Introduction to Plant Science
Introduction to Animal Science
Basic Electricity/Electronics
Basic Technical Drawing
Introduction to Reading Blueprints and Drawings
Introduction to Basic Textiles and Design

Working with 140 teams around the state, the Division of Occupational Education Services developed, field tested, and revised elaborate syllabi for the Home and Career Awareness course, the Introduction to Technology course, and for each of the 26 modules available in Introduction to Occupations. Team membership included teachers, department chairpersons, teacher educators, special educators, and representatives of business and industry. The syllabi are intended to (1) standardize occupational education in New York and (2) serve as minimum state standards for the provision of occupational education.

Evaluation

The state has scheduled phase-in of the new occupational education curriculum and sequence requirements over several years. Most districts began implementation of the junior high school courses and Introduction to Occupations two years ago. Beginning with the class of 1989, all sequences offered in local districts must be state-approved and credit requirements must be met. The class of 1990 will have to meet new content requirements and in 1991, students following an occupational sequence must pass a state proficiency examination on the two required modules of Introduction to Occupations. This examination is currently being field tested and normed. Many occupational clusters also have or will have state-developed vocational specialty tests including a written exam and performance or laboratory components. When the evaluation system is totally in place, schools will submit results to the state and receive in return a Comprehensive Assessment Report comparing a school's or district's outcomes with others in their region and statewide.

While the longer term effects of the innovation on student course taking and postschool outcomes will not become apparent for a number of years, early evidence suggests that at least some elements of the new occupational education are taking hold. For example, there has been a dramatic increase in enrollment in the occupational education courses that carry academic credit. Such enrollments have risen nearly 40 percent in one year, with enrollments in technology education alone increasing by 16 percent.

III. Specific Strategies in the Implementation of the New Approach

Curriculum

As detailed in the previous section, at the junior high or middle school level, the new state occupational education curriculum essentially replaces industrial arts and home economics as we have known them with required courses in technology education and home and career skills. We visited one junior high school to talk with administrators and teachers about the new approach. In general, the junior high school teachers seemed to be largely uncritical and supportive of the new curriculum. An occupational education supervisor at Shaker High School confirmed this impression, based on his knowledge of statewide implementation of the reform. It is entirely possible that junior high school vocational educators are particularly receptive to innovation at this time because they have found themselves in a backwater for so long. To some extent, at least, they are gratified that educational reformers are beginning to realize something that they have known for a long time: In the difficult early adolescent years, a combination of hands-on activities and puzzles (problem solving) is as close to a sure-fire motivator as a teacher can come. The new curriculum sanctions both.

At the high school level, however, we heard a somewhat different story. A supervisor who has participated in statewide inservice training estimated that perhaps 60-70 percent of the state's high schools are implementing the new curriculum as it had been conceptualized. He believes that other schools and districts will be forced to pay closer attention to the mandated changes as the required occupational education competency tests come into play.

Albany High School has offered Introduction to Occupations for two years. As in other schools across the state, responsibility for staffing the required portions of the introductory course has largely fallen to one occupational education department--in this case business and office education. This year, the school offered 19 sections of Introduction to Occupations. In addition to the two required modules, the Business Department chose to present Economics of Work and Introduction to Business Records during the second semester. The supervisor of business programs sees these latter two modules as both life skills courses and recruitment mechanisms for upper level business courses. However, next year they will reverse the order of the required and elective modules, offering the required segments in the spring just before administration of the state tests.

The occupational education departments at Albany High have not been entirely happy with the new curriculum design. In part, their grievances are based on what they see as an essential unfairness to students. Although the state-mandated occupational education competency tests are not yet fully in place, teachers are worried about the possible outcomes of this imminent layer to the reform. Students must pass the examination in order to earn sequence credit, and they must earn sequence credit in order to receive a diploma. Albany High teachers and supervisors speculate that because of the test, some unknown number of students will complete four years of high school and yet be deprived of a credential. For other students, the introductory course is perceived to be too simplistic, yet there is no option for them to "test out." However, teachers here do not agree with their colleagues at other schools that Introduction to Occupations should be "beefed up" and offered in the twelfth grade as an exit course.

Another sore spot is the scope of the two required modules in the Introduction to Occupations course. Teachers find that there is too much material to cover in a single semester: 49 discrete topics in 10 weeks. On the other hand, they have discovered considerable duplication among the modules and are still working on sorting out the redundancies.

At Shaker High School we met with the supervisor and teachers of home economics and technology education. In contrast to Albany High, here the required Introduction to Occupations modules are the responsibility of each occupational education area. The supervisor strongly believes that the new curriculum encourages much greater integration of reading, writing, and thinking into occupational programs. Furthermore, students gain a much broader introduction to career possibilities at a point prior to being locked into an occupational sequence. He teaches a section of the course himself and is pleased with the way that it stretches students' understanding of the real world.

The occupationally related academic courses allowed by the Regents Action Plan seem to be the slowest portions of the New York plan to get off the ground. Shaker High School will initiate an occupationally related mathematics course for the first time next year. Two classes with about 12 students each are planned. The development team for the course has included technology education and home economics teachers, a math teacher, the math supervisor, and a guidance counselor. The class will target the lowest achievers in math and offer them a different delivery system. Instructors will include a math teacher for the full year and a home economics teacher and a technology education teacher each for half a year. Planning for this applied math class is continuing over the summer. If it succeeds, the school may try a related science course as well. According to an occupational education supervisor, occupationally related math is generally better accepted than occupationally related science.

Instructors

Changes in the curriculum have necessarily had repercussions in other areas, including teacher preparation and certification. At the junior high school level, the new emphasis on technology education raised the issue of who was qualified to teach Introduction to Technology. Teachers certified in industrial arts and agriculture have been designated eligible to teach the full course, while science teachers may take responsibility for certain modules such as "How People Use Technology to Solve Problems" or "Impacts, Decision and Choices: Technological Assessment." Home economics teachers may teach all aspects of the Home and Career Skills course. In addition, teachers certified in business education, agriculture, health education, and guidance may teach or team teach certain Home and Career Skills units.

All teachers certified in an occupational education subject are eligible to teach the two required modules of Introduction to Occupations. The 24 elective modules are taught by specialists in various occupational fields, as appropriate. Occupationally related math and science courses may be offered by academically certified teachers in those fields or by a degreed occupational education instructor who can demonstrate at least six semester hours of college math or science.

State-level architects of the occupational education curriculum revision effort were well aware from the beginning that successful implementation of their plan would require significant staff development initiatives. Consequently, they identified and trained a cadre of teachers and supervisors who could in turn provide training and technical assistance to their colleagues across the state. Since many teachers had been involved from the outset of the change process as liaisons to the Futuring Committees, the new conceptual framework for the curriculum was relatively familiar to a core group of practitioners at the time of implementation.

The supervisor of secondary school technology education and home economics programs in Albany reported that she and other teachers from the district attended a state-sponsored inservice workshop prior to the first year of implementation. The workshop was presented by educators who had been engaged in writing the new curriculum, and their enthusiasm infected the participants. This supervisor had herself been a part of the Futuring phase in the revision of the home economics curriculum. In her experience, home economics teachers had long been dissatisfied with the traditional "aprons and bibs" approach to their specialty and were poised to embrace an updated syllabus with more relevance to the lives that their students will lead. The junior high school technology education teachers she supervises have been equally receptive to the recasting of industrial arts as technological problem solving.

At least at this junior high school, the new curriculum has caused the occupationally certified teachers to take the initiative in consulting with academic teachers about ways in which Home and Careers and Introduction to Technology can reinforce the skills students are mastering in other classes. No formal structures for inter-teacher communication have been established; rather, individual teachers make informal contact. A technology education teacher pointed out that technology is, by its very nature, interdisciplinary. It is only sensible, then, to exchange ideas and work cooperatively with social studies, math, science, and English teachers. A school administrator reported that social studies teachers are beginning to see natural links with the technology education course, and English is increasingly oriented toward the technology of word processing.

A home economics teacher told us that she feels pleasantly challenged by the new curriculum. She has, with her supervisor's encouragement and assistance, undertaken research to find new projects and activities that fit with her syllabus and challenge students' creative thinking skills. She has discovered the Extension Service as a source of ideas and materials such as a unit on heat loss in the home. As part of a housing safety unit, she and an English teacher worked cooperatively with students on an essay assignment. The English teacher graded the theme for competency in writing skills and the home economics teacher evaluated the content. For this teacher, the greatest challenge has come in identifying ways to integrate decision making and problem solving throughout the units of the curriculum.

At one of the high schools we visited, teachers were described as initially skeptical about the new curriculum, although they were not resistant. At this point, two years into implementation, the faculty members whom we interviewed and observed at the school appeared to be on the road to accepting Introduction to Occupations as the status quo. Some instructors have found that a period of educational change offers opportunities to sharpen their professional profiles. For example, a supervisor/instructor at Shaker High School has been selected to direct a statewide inservice program. He will organize, train, and schedule teams of three technology education teachers and one administrator to run a series of half-day workshops around the state.

Classroom Practices

The Introduction to Technology classes at the junior high stress a problem-solving approach. We visited one seventh grade class where students were preparing to launch the model rockets that they had been working on for several weeks. The objective of the unit was to understand the parts of a system, in this case the fins, body, etc., that make up the vehicle. In another project completed by this class earlier in the year, students were given a block of wood and asked to design and make "something" that will move in water the length of the classroom's industrial size sink.

Outside on the athletic field, the students pretended not to care whether their particular rockets had a good flight. On the first launch, the parachute failed to open and the rocket plummeted to earth. One boy speculated, "I think it was because of the wadding," implying that he would like to remove said material from his own model. The instructor reminded him that the wadding is necessary to keep the parachute from burning during launch. The point is, however, that while the students inevitably acted their age when released onto the field, they did attend to each launch and gave some thought to why rockets went higher or lower or crashed. In short, they were engaged in scientific hypothesizing.

In a section of Introduction to Occupations at Albany High School, students were reviewing a lesson on preparation of payrolls. Nearly all the students were ninth graders. The teacher handed out a worksheet containing problems like the following:

(1)	M	T	W	Th	F	Total hours	Wages per hour	
	8	7-1/2	8-3/4	6	8-1/4	_____	$4.96	$_____

(2)	Hours	Wages	Deductions	Net pay
	38-1/2	$5.12	$38.25	_________

The exercises, which were handwritten and xeroxed, tested basic mathematical operations such as addition of fractions, conversion of fractions to decimals, multiplication, and subtraction. Students worked busily and were eager to put their solutions on the board. One girl asked what decimal the fraction 3/4 equals? The instructor answered her quickly and directly rather than helping the student figure it out. While the class may help these students figure out their own timesheets when they are employed, its principal goal seemed to be a review of basic arithmetic.

At Shaker High School, we observed in another section of Introduction to Occupations. This time the class was held in an old auto body shop. Twenty students--all boys--were present. Like most of the classes we visited in this late May time slot, the instructor was helping students review for the final exam. This particular day's lesson included a review of financial terms such as amortization, assets, fixed expenditures, capital, collateral, etc. Some students seemed to be paying attention throughout; others were apparently disengaged, yet moved back into the flow of the discussion when something interested them. This teacher did a good job of using examples to describe big words or complex ideas that were meaningful to the audience. Nearly everyone perked up during a discussion of the term "co-signer" when the instructor asked a boy whether he had a co-signature on the purchase agreement for his motorcycle. The questions started to flow: What if you're late on a payment? Is there a time period when they can't take the vehicle back? A little math was introduced into the discussion of "equity." "If I buy a $50,000 home, sell it for $105,000 but still owe the bank $30,000, what is my equity?" The students got the answer easily.

It is unfair to make generalizations about a nine-week course (module) based on a single point observation. It did seem to us, however, that the junior high school classes we witnessed were doing more to challenge students to think and apply knowledge than were the Introduction to Occupations modules. We can speculate on several reasons for this observation. First, at the high school level, teachers are, in part, preparing students for a test, which may cause them to concentrate on "covering the material." Second, the junior high school teachers seem to have a greater sense that they are participating in a bold new undertaking that to some extent throws off old constraints and frees them to experiment with new instructional strategies as well as new content. Third, the age groups are different. No self-respecting 15-year-old can afford to seem interested in anything, and our impressions may be colored by their apparent ennui.

IV. Issues

Relationships with Academic Educators

Developing and implementing a revised occupational education curriculum has been a massive undertaking in New York. The sheer scale of this effort puts it in a different category from the other four sites that we visited. It also differs because it puts the burden for better integrating vocational and academic education squarely at the door of the occupational education community. Academic subject specialists have been consulted along the way, but academic teachers are not being required to change their ways of thinking. Nor are academic and vocational educators systematically being brought into new relationships.

This continued division between "us" and "them" has caused state occupational education administrators some headaches. As one of them candidly told us, "Getting decisions on granting academic credit for occupational or occupationally related courses has been bloody!" Quite recently, the Assistant Commissioner and the Director of the Division of Occupational Education Services have sent a proposal to the Commissioner that would begin to break down some of the barriers between occupational and academic education. They believe that is ultimately wrong to force students and their families to choose between academic or occupational education. They suggest that schools should offer two types of diplomas: Technical Education or Liberal Arts. All students would take the mandated number of courses in the various disciplines, as required by the Regents Action Plan. Technical Education majors would also be required to show two 3-unit or one 5-unit sequence in math, science, occupational education, and/or a second language, while Liberal Arts candidates would take three units of foreign language and two of art, music, or additional English. The objective of this plan is, at least partially, to remove some of the stigma from the occupational aspect of technical education and give it legitimacy among math and science-oriented students who may have a variety of post-high school plans.

Relationships with Higher Education

The results of the occupational education curriculum revision for secondary schools has major implications for New York postsecondary institutions. For example, teacher preparation programs must account for the new certification requirements that appear in state regulations related to the innovation. However, a more serious problem may be the state of articulation between the high schools and the community colleges. The Futuring process involved community college personnel, and in the course of those contacts, the secondary school leadership began to realize that there is serious dissonance between mandated curricula and testing at the high school level and the total lack of same at the postsecondary level. In some high school occupational education programs--accounting, for example--students will graduate with the equivalent of six community college credits. Because the community colleges have been slow to make allowances for the increased levels of preparation of high school graduates, they are losing students to proprietary schools.

While nearly all the sites we visited have more or less active articulation agreements with local institutions of higher education, New York is the only place where such coordination assumed the dimensions of a major issue. It is possible, however, that it is a topic that we slighted in our interviewing and that looms large on the horizon of the 1990s.

Evaluation

The state has developed a testing system to accompany the curriculum revision and has an occupational education data system in place to track enrollments and post-high school outcomes. This is more than many states do effectively. We wonder, though, how one can determine whether the new approach is significantly better than other approaches to the delivery of both occupational education and the integration of basic or academic skills into occupational education. Specific issues that occur to us include the following:

- The state has developed very detailed syllabi, almost down to the lesson plan level, that make very clear the types of learning and activities that it considers appropriate. Nevertheless, how can the state determine in any systematic way what is happening behind the classroom door?
- The new testing system will tell how well students are doing in the required Introduction to Occupations modules and, in some cases, how well they have done in their overall occupational specialties. Will it, however, shed light on whether the new approach is better than the old? Whether students have a better grasp of basic skills, problem solving, and academic applications? What are the baseline data?

APPENDIX B

EXAMPLES OF COMPLETED TECHNICAL WRITING ASSIGNMENTS

Technical Report No. 1: A-10-5 Weld Triple Pass Tee Flat 6013 .... B-1

Technical Report No. 2: Instrumental Analytical Chemistry Fat Determination Using Soxhlet Extraction B-7

Technical Report No. 3: A general Description of Spico Harvesters B-15

A-10-5 WELD TRIPLE PASS TEE FLAT 6013

PERFORMANCE OBJECTIVE:

Given the equipment, tools, and materials listed below, the student will weld a triple pass tee flat 6013. The completed job must be centered with the ends even. Each pass will be smooth and even without any holes or burn-throughs. The welds will be consistent in width throughout their lengths.

PERFORMANCE GUIDE:

Equipment and Tools Required: AC/DC welding machine, welding helmet, leather welding gloves, chipping hammer, welding jacket, standard pliers, and 10" tape measure.

Material Required: 1 piece of mild steel 1/4" x 1" x 12", 1 piece of mild steel 1/4" x 2" x 12", and 1/8" 6013 electrodes as needed.

Safety Hazards: weld flash, and burns from hot metal.

Procedure:
1. Observe demonstration.
2. Secure tools and materials.
3. Close curtain.
4. Set machine and turn on.
5. Weld tee joint.
6. Clean slag and wire brush.
7. Evaluate and inspect.

INFORMATION SHEET

Sign out the following tools from the tool room: welding helmet, leather welding gloves, welding jacket, chipping hammer, 10' tape measure, and standard pliers. Take the tools to the art welding area located at the right rear of the shop. Using the tape measure, secure the 1/4" a 1" x 10' and 1/4" x 2" x 10' mild steel from the metal rack which is located in the loft at the top of the stairs.

Use the horizontal band saw or a travel cutting torch (job 3: four pass plate) to cut the metal. Cut one piece of mild steel 1/4" x 1" x 12" and one piece 1/4" x 2" x 12". Return the unused steel to the same rack it was obtained from.

From the black cabinet at the back of the shop, secure at least six 6013 electrodes. After obtaining the electrodes, prepare the arc welder. Hook the ground clamp to either the tee joint or the metal welding table. If the ground cable is clamped to the table, the material can be repositioned and the clamp will not fall off or lose contact. Set the amperage to either 100 or 110 amps. When welding the tee joint with 6013 electrodes, set the polarity indicator to AC (alternating current). Use the switch located on the upper left hand corner of the welder (when facing the welder) to turn the welder on (Illustration 1).

Insert the 6013 electrodes in the electrode holder after squeezing the handle (Illustration 2). Position the 1/4" x 1" x 122" piece of mild steel and hold it at a 90° angle on top of the 1/4" x 2" x 12" piece of mild steel. The top piece of steel (1/4" x 1" x 12") should be centered on the bottom piece of steel (1/4" x 2" x 12") and the ends should be even (Illustration 3).

Once the metal is positioned, make two temporary tack welds on each end of the joint to temporarily secure the joint as shown in Illustration 3. Strike an arc at each end of the material, and lightly bond the two pieces of metal. Chip off the slag with a chipping hammer and wire brush the tack welds.

To make the first pass on the tee joint, hold the rod (electrode) on a 45° angle to the joint and move from left to right in a series of half-moon motions for an even, rippled weld (Illustrations 4 and 5 [green]). Weld to the end of the tee joint. Chip away the slag and wire brush the weld so that it is smooth and even without any holes.

On the second pass, hold the rod at a 55° angle to the joint and weld, lapping halfway up the first bead and butt against the bottom piece of metal (Illustrations 5 and 6 [purple]). Begin the second pass at the left and stop about 2" from the end of the joint. Chip away the slag and wire brush the weld.

On the third pass, hold the rod at a 35° angle to the joint and weld, lapping halfway down the first bead, and butting against the upper or vertical piece of metal (Illustrations 5 and 6 [orange]). Start the weld flush at the left and stop this pass about four inches from the end of the joint. Chip away the slag and wire brush the welds.

When three passes are welded across the joint, it ensures a stronger weld. There is up to three times the penetration in the material that has been welded, which produces a much stronger tee joint than a single weld. Stop 2" and 4" from the end on the second and third passes respectively so the welds can be properly evaluated.

Criteria:

The material should be centered with the ends even. Each pass should be smooth and even without any holes or burn-throughs. A burn-through occurs when the metal gets too hot at any point and a hole is burned through the base material being welded. The welds should be consistent in width throughout their lengths without undercuts.

GLOSSARY

1. AC (alternating current) -- the type of electrical current which reverses its direction of electron flow regularly.

2. Ampere -- unit of electrical current. One ampere is required to flow through a conductor having a resistance of one ohm at a potential (pressure) of one volt.

3. Arc -- flow of electricity through a gaseous space or air gap.

4. Slag -- a nonmetallic by-product of smelting, refining, and welding which is made up of flux and nonmetallic impurities.

5. Tack weld -- a small, light weld to temporarily secure a joint.

6. Undercut -- a depression at the toe of the weld which is below the surface of the base metal.

A-10-5 WELDING A TRIPLE PASS TEE FLAT 6013 QUIZ

1. When welding the first pass on the tee joint, hold the rod at a ________ __________° angle.

2. When using the 6013 electrode, set the polarity indicator at _______________.

3. When welding the tee joint with 1/4" thick of mild steel, the amperage should be set at _________________ or ____________________.

4. A ___________________________ is used to chip away the slag and wire brush the welds.

5. Hold the rod at a __________° angle when welding the third pass on the tee joint.

6. Describe the purpose of a tack weld.

7. A ____________________ -___________________ is when the metal gets too hot at a certain point and a hole is burned in the base metal.

8. Describe why it is better to weld three passes across the joint rather than one pass.

9. ________________________ _______________________ is the type of electricity which reverses its flow regularly.

10. Use a horizontal ____________________ or a _____________________ to cut the mild steel.

ANSWER KEY FOR A-10-5 WELDING A TRIPLE TEE FLAT 6013

1. 45°

2. AC (alternating current)

3. 100 or 110

4. chipping hammer

5. 35°

6. to temporarily secure the metal in place before welding the joint

7. burn-through

8. With three passes there is three times the penetration in the material being welded. This produces a much stronger joint.

9. Alternating current

10. bandsaw or cutting tooth

INSTRUMENTAL ANALYTICAL CHEMISTRY
FAT DETERMINATION USING SOXHLET EXTRACTION

PERFORMANCE OBJECTIVE:

Accurately use a soxhlet extraction set-up in a fat determination to +/- 0.4%.

PERFORMANCE GUIDE:

Equipment: balance (+/- 0.0001 g. sensitivity), drying oven set at 110 degrees Celsius, hot plat, desiccator, 250 ml. flat bottom collection flask, soxhlet extraction tube, 100 ml. graduated cylinder, condenser to fit the extraction tube, heating mantle, and rheostat.

Materials: glass beads, fiberglass wool, 22 x 80 mm. soxhlet extraction thimble, stopcock grease, petroleum ether, and a chocolate sample.

Recommendations: Apply stopcock grease to the upper 2/3 of all joints (soxhlet extraction tube, flask, condenser) to prevent leading. Clean the flask and extraction tube by boiling with petroleum ether int he fume hood. When setting up the apparatus, build from the bottom up, placing the clamps from the back to the front. Illustration 1 shows the arrangement of the flask, soxhlet extraction tube, and the condenser.

INFORMATION SHEET

The accurate results of this experiment are traced to a very basic rule of chemistry: like dissolves like, and similar compounds tend to mix. Oil and water (organic versus inorganic, or non-polar versus polar) do not mix. This rule is used in several types of analyses.

The basis of this rule is the polarity of the compound. Some compounds are polar (H_2O), some are non-polar (oil), and some are both polar and non-polar (detergents).

Most polar compounds are inorganic. This is due to the fact that inorganic compounds* undergo only two types of bonding: ionic bonding* and polar covalent bonding*. These bonds are common in inorganic compounds. Some organic compounds contain these bonds, but to remain polar, the carbon chains must be short, generally four carbons or less like ethyl alcohol:

This type of bonding is polar and is similar to the bonding of a water molecule (H-OH) which allows ethyl alcohol and water to mix, as they are both polar. For information about the types of bonds (polar and non-polar), see the Glossary.

Non-polar compounds* tend to be organic molecules with higher molecular weights,* as in this experiment. Organic compounds* undergo a different type of bonding. Electrons are shared, and this type of bonding is known as covalent non-polar bonding.* Non-polar bonds resist polar compounds. There are usually no polar bonds present. If polar bonds are present, they are weaker than the non-polar bonds which cause the compound to remain non-polar:

The polar bond is weaker than the more numerous non-polar bonds, therefore the compound remains non-polar.

There are also compounds that are both polar and non-polar. These have strong ionic bonds which weigh equally against the non-polar bonds. An excellent example is a detergent:

The non-polar end of a detergent breaks down fats, oils, and dirt, while the polar end allows the mixture to remain water soluble. This is what makes a detergent suitable for most cleaning purposes.

In this fat determination, fat from a sample is dissolved by refluxing (boiling and condensing) petroleum ether through the sample (chocolate in this experiment). The fat is then isolated by boiling off the petroleum ether. Both fat and petroleum ether are non-polar, which is why petroleum ether is a suitable solvent for a fat determination.

PROCEDURE

(Asterisked words defined in Glossary)

1. Petroleum either is flammable; avoid working near sparks or flames.

2. Place the collection flask in the set-up. Add 100 ml. of petroleum ether and two glass chips to prevent splattering. Boil for ten minutes. Make sure no fumes are coming out of the condenser. If there are fumes, make sure the cold water is turned on. Take the flask and the soxhlet extraction tube to the fume hood*. Empty the petroleum ether into the recycle bottle. Rinse the flash and extraction tube with 20 ml. of petroleum ether. Pour the ether into the recycle bottle and proceed to Step 3.

3. Accurately weigh 2.0 grams (+/- 0.0005 g.) of finely ground chocolate (mortar and pestle*). Place the sample (chocolate into the soxhlet extraction thimble.

4. Place a wad of fiberglass wool into the top of the thimble.

5. Place the thimble in the soxhlet extraction tube.

6. Place some glass beads (5-10) in the 250 ml. flat bottom collection flask.

7. Dry the flask, with the glass beads, to constant weight* at 100 degrees Celsius.

8. Record the weight to the nearest 0.0001 gram.

9. Assemble the condenser, extraction tube, flask, heating mantle, and rheostat from the bottom up as shown on the previous page. Make sure the joints are well greased to prevent any leaks. Grease the upper 2/3 only, so the grease will not contaminate the sample.

10. Be sure the V-jaw clamps are placed so that they do not touch the glass tubing (siphon on Illustration 1) on the outside of the soxhlet extraction tube.

11. Pour 160 ml. of petroleum ether into the flask through the condenser.

12. Turn on the cooling water. Set the rheostat at 80.

13. Bring the system to a gentle boil. Make sure the condenser is cool. There should be no visible condensation on the outside of the condenser. If condensation occurs, it is too cool; reduce the water rate.

14. Extract for six hours at a siphoning rate* of once every two minutes. This is done by adjusting the rheostat (higher to increase rate, lower to decrease rate).

15. Remove the apparatus from the heating mantle.

16. Remove the grease from the joints using ethyl alcohol and cotton.

17. Place the flask on a hot plate in the fume hood and evaporate the petroleum ether until about 5 ml. remain (about the size of a quarter). Observe the flask closely during this step, as the petroleum ether could reach its flash point* (fire hazard).

18. Place the flask in the drying oven for four hours at 110 degrees Celsius.

19. Place the flask in the desiccator for thirty minutes.

20. Weigh the flask to the nearest 0.0001 gram.

21. Calculate the percentage of fat:

$$\% \text{ fat} = \frac{\text{weight gain in collection flask}}{\text{weight of sample}} \times 100$$

GLOSSARY

1. Constant weight -- obtained by heating object (flask) to 110 degrees Celsius several (2 or more) times until the weights are consistent (+/- 0.0005 grams)

2. Covalent non-polar bond -- atomic bond in which both atoms involved equally share a pair of electrons. For example:

   The atoms are both the same; therefore, they will equally conflict over the electron pair.

3. Flash point -- lowest temperature at which a substance will ignite or combust.

4. Fume hood -- safety apparatus designed to prevent forced exposure of toxic, flammable, and volatile gases.

5. Inorganic compounds -- generally, those which do not contain carbon.

6. Ionic bond -- atomic bond in which there is a transfer of electrons, producing opposite charges on each atom which unites them. For example:

7. Molecular weight -- weight of one molecule.

8. Mortar and pestle -- instrument used to reduce particle size by grinding.

9. Non-polar compound -- compound that does not have charged ends (covalent).

10. Organic compound -- carbon based compound.

11. Polar compound -- compound that has charged ends (see Ionic bond).

12. Polar-covalent bond -- atomic bond in which electrons are unequally shared to produce charged ends. For example:

    The chlorine atom attracts the pair of electrons more than the hydrogen atom, creating a partial charge at both ends.

SOXHLET EXTRACTION FAT DETERMINATION QUIZ

1. Is oil polar or non-polar?
2. Describe and give an example of a polar compound.
3. Describe the process for obtaining constant weight.
4. Define flash point.
5. In a fat extraction, what is the solvent and what properties make it suitable for this experiment?
6. Why are the joints greased?
7. Explain shy a detergent is suitable for cleaning purposes (based on polarity).
8. What is used to grind the sample?
9. Define and give an example of an ionic bond.
10. Define and give an example of a non-polar covalent bond.

ANSWER KEY FOR SOXHLET EXTRACTION FAT DETERMINATION QUIZ

1. Oil is non-polar.

2. A polar compound is a compound that has charged ends; sodium chloride (NaCl) is a good example.

3. Constant weight is obtained by heating an object (flask) to 110 degrees Celsius several (2 or more) times until the weights are consistent.

4. The flash point of a substance is the lowest temperature at which a substance will ignite or combust.

5. The solvent is petroleum ether, and it is non-polar which makes it a suitable solvent for fat.

6. The joints are greased to prevent leaking.

7. A detergent has a non-polar end for breaking down dirts and fats, and a polar end to make the mix water soluble.

8. A mortar and pestle is used to grind the sample.

9. An ionic bond is an atomic bond in which there is a transfer of electrons producing opposite charges on each atom which unites them. For example:

10. A non-polar covalent bond is an atomic bond in which electrons are equally shared between atoms. For example:

    The atoms are both the same; therefore they will equally conflict over the electron pair.

H.T. English 3
February 4, 1987
Ms. Pugliano

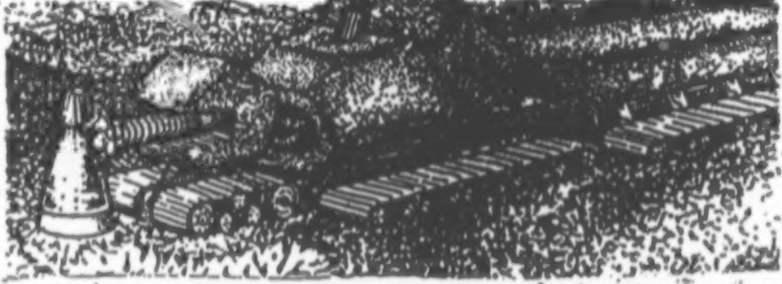
A General Description of Spice Harvesters

Spice harvesters are machines used to mine spices out of the deserts of Dune. They were used by spice miners due to the rigors of their occupation. Spice harvesters can be described by physical characteristics, parts, and use.

Physical characteristics

The appearance of a spice harvester can be best described as a long rectangle on wheels. Made of stainless steel and plasti-steel, harvesters weigh ten-thousand pounds.

Fig. 1- spice harvester



Spice harvesters are huge; thirty feet long and ten feet high. The length and height may vary if a factory is attached or not, but the parts are the same and they are used in the same way.

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Parts:

The spice harvester consists of four parts: the cone, the control tower, the vacuum pump, and the wheels.

Cone. The cone is a ten-foot high metallic funnel attached to the control tower. The use of the cone is to send the waste brought in with the ore out of the harvester so that it will not contaminate the ore.

Control Tower. The control tower is the most important part of the harvester. Here the miners use specialized devices to sort the ore and the waste. The waste is then sent through the cone and back into the desert. The wheels are also controlled through the control tower.

Vacuum pump. The vacuum pump is mounted on front of the harvester and pulls ore into the harvester. It is a circular tube that requires regular maintenance to stay working.

Wheels. The wheels consist of a network of arms and tracks

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February 4, 1987
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that are operated by the miners inside the harvester. They make the spice harvester mobile and thus reduce the risk of attack by a sandworm.

Using Spice Harvesters

Spice harvesters are used in the following way. The harvester moves out on the wheels while the vacuum pump scans directly out in front of the harvester gathering ore. Inside the control tower the miners sort the ore and waste out. The ore is sent back to the factory and the waste goes through a tube and out the cone where it is sent back into the desert.

Excellent
A
The format as well as the content is very well done.

APPENDIX C

BIBLIOGRAPHY

BIBLIOGRAPHY

Baldwin, D. (1984, September). The thinking strand in social studies. Educational Leadership, 42(1), 79-80.

Baron, J., & Brown, R. V. (1988, August 7). Why America can't think straight. The Washington Post, p. B3.

Bereiter, C. (1982, April). Structures, doctrines, and polemical ghosts: A response to Feldman. Educational Researcher, 11(4), 22-25.

Bereiter, C. (1984, September). How to keep thinking skills from going the way of all frills. Educational Leadership, 42(1), 75-78.

Berryman, S. E. (1988, April). Education and the economy: What should we teach? When? How? To Whom? New York City: National Center on Education and Employment, Teachers College, Columbia University. Occasional paper no. 4.

Brandt, R. (1984, September). Overview. Educational Leadership, 42(1),3.

Brophy, J. (1988, December). Effective schooling for disadvantaged students. Unpublished paper prepared for SRI International's Study of Academic Instruction for Disadvantaged Students.

Carnevale, A., Gainer, L. J. & Meltzer, A. S. (1988). Workplace basics: The skills employers want. Alexandria, VA: American Society for Training and Development.

Carraher, T. N., Carraher, D. W., & Schliemann, A. D. (1985, March). Mathematics in the streets and in schools. The British Journal of Developmental Psychology, 3, 21-29.

Catterall, J. S., & Stern, D. (1986, Spring). The effects of alternative school programs on high school completion and labor market outcomes. Educational Evaluation and Policy Analysis, 8(1), 77-86

Chipman, S. F. (1987, March). What is meant by "higher-order cognitive skills." Paper prepared for the National Assessment of Education Progress.

Chipman, S. F., & Segal, J. W. (Eds.). (1985). Thinking and learning skills: Vol. 2. Research and open questions. Hillsdale, NJ: Lawrence Erlbaum Associate.

The College Board. (1984). Academic preparation for the world of work. New York: author.

de Bono, E. (1984, September). Critical thinking is not enough. Educational Leadership, 42(1), 16-17.

Feldman, D. H. (1981, November). Beyond universals: Toward a developmental psychology of education. Educational Researcher, 10(9), 21-31.

Feldman, D. H. (1986). Nature's gambit. New York City: Basic Books.

Fisher, A. D., and Cole, R. L. (1981, Summer). Cognitive mapping and vocational students in selected Oregon community colleges. Journal of Vocational Education, 6(3), 57-76.

Gardner, H. (1983). Frames of mind: The theory of multiple intelligences. New York: Basic Books.

Gardner, H. (1987). An individual-centered curriculum. In The schools we've got, the schools we need. Washington, D.C.: Council of Chief State School Officers.

Glaser, R. (1987). Thoughts on expertise. In C. Schooler & K. W. Schaie (Eds.), Cognitive functioning and social structure over the life course. Norwood, NJ: Ablex Publishing Corp.

Goodlad, J. (1983). A place called school. New York: McGraw Hill.

Greena, J. G. (1985). Looking across the river: Views from the two banks of research and development in problem solving. In S. F. Chipman & J. W. Segal (Eds.), Thinking and learning skills: Vol. 2. Research and open questions. Hillsdale, NJ: Lawrence Erlbaum Associates.

Hayes, J. R. (1985). Three problems in teaching general skills. In S. F. Chipman & J. W. Segal (Eds.), Thinking and learning skills: Vol. 2. Research and open questions. Hillsdale, NJ: Lawrence Erlbaum Associates.

Hotchkiss, L. (1984). Effects of schooling on cognitive attitudinal and behavioral outcomes. Columbus, OH: NCRVE.

Klemp, G. O. (1988, May/June). The meaning of success: A view from outside the academy. Liberal Education, 74(3), 37-41.

Lave, J., Murtaugh, M., & de la Rocha, O. (1984). The dialectice of arithmetic in grocery shopping. In R. Rogoff & J. Lave (Eds.), Everyday cognition: Its development in social context. Cambridge, MA: Harvard University Press.

Lipman, M. (1984, September). The cultivation of reasoning through philosophy. Educational Leadership, 42(1), 51-56.

Miller, J., Slomczynski, K. M., & Kohn, M. L. (1987). Continuity of learning-generalization through the life span: The effect of job on men's intellectual process in the United States and Poland. In C. Schooler & K. W. Schaie (Eds.), *Cognitive functioning and social structure over the life course*. Norwood, NJ: Ablex Publishing Corp.

National Commission on Secondary Vocational Education. (1984). *The unfinished agenda: The role of vocational education in the high school*. Columbus, OH: The National Center for Research in Vocational Education.

Nickerson, R. S., Perkins, D. N., & Smith, E. E. (1985). *The teaching of thinking*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Nickerson, R. S. (1984, September). Kinds of thinking being taught in current programs. *Educational Leadership*, *42*(1), 36-37.

Packer, A. (1988, July 10). Retooling the American worker. *The Washington Post*, Section C.

Paul, R. W. (1984, September). Critical thinking: Fundamental to education for a free society. *Educational Leadership*, *42*(1), 4-15.

Perkins, D. N. (1985). General cognitive skills: Why not? In S. F. Chipman & J. W. Segal (Eds.), *Thinking and learning skills: Vol. 2. Research and open questions*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Perrone, V. (1985). *Portraits of high schools*. Princeton, NJ: The Carnegie Foundation for the Advancement of Teaching.

Powell, A. G., Farrar, E. and Cohen, D. (1985). *The shopping mall high school: Winners and losers in the educational marketplace*. Boston: Houghton Mifflin.

Resnick, L. B. (1987, December). Learning in school and out. *Educational Researcher*, *16*(9), 13-20.

Resnick, L. B. (1987). *Education and learning to think*. Washington, DC: National Academy Press.

Rogoff, B., & Lave, J. (Eds.) (date?). *Everyday cognition: Its development in social context*. pub?

Rosow, J. M. and R. Zager. (1988). *Training--the competitive edge*. San Francisco: Jossey-Bass.

Scribner, S. (1985, Fall). Knowledge at work. *Anthropology & Education Quarterly*, *16*(3), 199-206.

Scribner, S. (1988, April). Head and hand: An action approach to thinking. Paper prepared for the Eastern Psychological Association Annual Meeting, Arlington, VA.

Sedlak, M. et al. (1986). Selling students short: Classroom bargains and academic reform in the American high school. New York: Teachers College Press.

Segal, J. W., Chipman, S. F., and Glaser, R. (1985). Thinking and learning skills: Relating instruction to research. Hillsdale, NJ: Lawrence Erlbaum Associates.

Sternberg, R. J. (1984, September). How can we teach intelligence? Educational Leadership, 41(1), 38-50.

Sticht, T. G. (1977). Comprehending reading at work. In M. A. Just & P. A. Carpenter (Eds.), Cognitive processes in comprehension. Hillsdale, NJ: Lawrence Erlbaum Associates.

U.S. Department of Education, The National Commission on Excellence in Education. (1983) A nation at risk: The imperative for education reform. Washington, D.C.: U.S. Government Printing Office.

Walberg, H. J. (1987). Learning and life-course accomplishments. In C. Schooler & K. W. Schaie (Eds.), Cognitive functioning and social struction(?) over the life course. Norwood, NJ: Ablex.

Weber, J. M. et al. (1982, January). A quantitative study of basic skills and vocational education. Columbus, OH: Ohio State University, National Center for Research in Vocational Education.

Whimbey, A. (1984, September). The key to higher-order thinking is precise processing. Educational Leadership, 42(1), 66-70.

Youth and America's Future: The William T. Grant Foundation Commission on Work, Family and Citizenship. (1988, November). The forgotten half: Pathways to success for America's youth and young families. Washington, D.C.: author.

Zenke, L., & Alexander, L. (1984, September). Teaching thinking in Tulsa. Educational Leadership, 41(1), 81-84.